THE ENGLISH CYCLOPÆDIA.

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ENGLISH CYCLOPÆDIA.

A New Dictionary of Universal Knowledge.

CONDUCTED BY CHARLES KNIGHT.

NATURAL HISTORY.—VOLUME II.

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NATURAL HISTORY.

CLIVI'NA, a genus of Coleopterous Insects of the family *Scaritidæ*, and section *Geodephaga*. It has the following characters:—Body elongate, somewhat cylindrical; antennæ moniliform, the basal joints rather long (the first longest), the remaining joints short and rounded; palpi with the terminal joint long and pointed; mentum trilobate; thorax nearly square; anterior tibiæ broad and compressed, with two notches externally, leaving three long pointed tooth-like processes; the intermediate pair of legs with one of these external processes on the tibia.

Dejean incorporates with this genus that of *Dyschirius*, but we think without sufficient reason.

These insects are of small size, and live under stones in damp situations, particularly on the margins of rivers, lakes, &c. Their dentated anterior tibiæ enable them to burrow like the Lamellicorn Beetles.

Of the genus *Clivina* but few species are known. In England there are two; the more common is *C. fossor* (or *C. arenaria* of some authors). This species is rather more than $\frac{3}{10}$ths of an inch in length, and of a black or brown colour; the legs, antennæ, and palpi, are reddish. *C. collaris*, the other British species, is rather less than the one just described. It is black, and has chestnut-red elytra, sometimes with a black dash on the suture.

The species of the genus *Dyschirius* are distinguished from those of *Clivina* principally by their having the thorax globular, the terminal joint of the palpi thicker in proportion, and somewhat securiform. The body is generally shorter in proportion, and more convex, or less cylindrical; they are almost always of a brassy metallic colour, whereas the species of *Clivina* are black or brown, and without any metallic hue.

Of the genus *Dyschirius* between twenty and thirty species are known. Their habits are much like those of the genus *Clivina*, but they are less frequently found under stones, and often make cylindrical burrows in the ground in banks at the margin of rivers or other pieces of water. Upwards of twelve species inhabit this country, the largest of which is scarcely more than one-eighth of an inch in length.

CLOANTHITE. [NICKEL.]

CLOT. [BLOOD.]

CLOTHO, a genus of Fossil Bivalve Shells, established by Faujas de Saint Fond. Shell oval, subregular, striated longitudinally, equivalve, subequilateral. Hinge formed by a bifid tooth, curved into a hook, a little larger in one valve than in the other. Ligament external.

CLOTHONIA. [BOIDÆ.]

CLOUDBERRY, a dwarf kind of Bramble, with herbaceous stems, and orange-yellow fruit, found in turfy alpine bogs; it is the *Rubus chamæmorus* of botanists. Its fruit is excellently well flavoured when newly gathered. [RUBUS.]

CLOVE-PINK, a species of *Dianthus*, so called from a supposed resemblance in odour between its flowers and the cloves of the shops. [DIANTHUS.]

CLOVER. [TRIFOLIUM.]

CLOVES. [CARYOPHYLLUS.]

CLUB-MOSS, or SNAKE-MOSS, is a prostrate moss-like plant, with small scaly imbricated leaves, found in alpine or damp situations in most parts of the world. Its fructification consists of little two-valved cases, containing powdery matter. All the species belong to the genus *Lycopodium*; that to which the name is most commonly applied is *L. clavatum*. [LYCOPODIUM.]

CLUNCH, a name given to the lower and harder beds of the Cretaceous Rocks. They are occasionally used for building purposes, and have been especially employed for internal work in cathedrals and other large public buildings. This material stands well if not exposed to accidents from mechanical violence. (Ansted, *Elementary Geology*.)

CLUPE'IDÆ, a family of Fishes of the section *Abdominales*. The *Clupeidæ* are placed by Cuvier between the *Salmonidæ* and the *Gadidæ*: in fact they form the fifth and last division of his section 'Malacopterygiens Abdominaux.' The fishes of this division may be distinguished by their wanting the adipose fin, by having the upper jaw composed of the intermaxillary bones in the middle, and the maxillaries at the sides, and by the body being always covered with scales. Some of the species ascend rivers.

The genus *Clupea*, as now restricted by Cuvier, may be thus characterised:—Maxillaries arched in front; opening of the mouth moderate; upper jaw entire; body compressed and covered with large scales; teeth minute or wanting. To this genus belong the Herring, Sprat, Whitebait, Pilchard, &c.

C. Harengus, Linn., the Herring (French, Le Hareng Commun), is a fish well known. Its characters however will be useful to distinguish it from some allied species; they are as follows:—

Small teeth in both jaws; suboperculum rounded; veins on the infra-orbitals and gill-covers; dorsal fin behind the centre of gravity; this fin commences about half way between the point of the upper jaw and the end of the fleshy portion of the tail; ventrals placed beneath the middle of the dorsal fin; tail forked; length of the head one-fifth of that of the body; the greatest depth of the body one-fifth of the whole length. The upper part of the fish is blue or green, according to the light; the sides, belly, and gill-covers are silvery-white; ordinary length, ten to twelve inches.

The term Herring is the same as the German Häring, which, according to some, is derived from Heer, an army, and is applied to these fishes from their visiting the coasts in such immense numbers.

"The Herring inhabits the deep waters all round the British coasts, and approaches the shores in the months of August and September for the purpose of depositing its spawn, which takes place in October, or the beginning of November. It is during these months that the great fishing is carried on, for after the spawning is over it returns to deep water. The mode of fishing for herrings is by drift-nets, very similar to those employed for taking mackerel and pilchard, with a slight difference in the size of the mesh. The net is suspended by its upper edge from the drift-rope by various shorter and smaller ropes, called buoy-ropes; and considerable practical skill is required in the arrangement, that the net may hang with the meshes square, smooth and even, in the water, and at the proper depth; for according to the wind, tide, situation of their food, and other causes, the herrings swim at various distances below the surface.

"The size of the boat used depends on the distance from shore at which the fishery is carried on, but whether in deep or in shallow water, the nets are only in actual use during the night. It is found that the fish strike the nets in much greater numbers when it is dark than when it is light: the darkest nights therefore and those in which the surface of the water is ruffled by a breeze are considered the most favourable. It is supposed that nets stretched in the daytime alarm the fish, and cause them to quit the places where that practice is followed; it is therefore strictly forbidden." (Yarrell.)

The young are found on our coast during the summer months in great abundance, and are often taken in small-meshed nets used for catching other fishes.

The food of the Herring consists principally of small *Crustacea*, but they have been known to devour the fry of their own species.

C. Leachii, Leach's Herring. This second species of herring was discovered by Mr. Yarrell, and described in the 'Proceedings of the Zoological Society' for 1831, p. 34. An account by the same gentleman is also given in the 'Zoological Journal,' vol. v., where a figure of the species will be found, as well as in his 'History of British Fishes.' The following is Mr. Yarrell's description:—

"The length of the head, compared to that of the body alone, without the head or caudal rays, is as one to three; the depth of the body greater than the length of the head, and, compared to the length of the head and body together, is as one to three and a half; it is therefore much deeper in proportion to its length than our common herring, and has both the dorsal and abdominal lines much more convex; the under jaw longer than the upper, and provided with three or four prominent teeth just within the angle formed by the symphasis; the superior maxillary bones have their edges slightly crenated; the eye is large, in breadth full one-fourth of the length of the whole head; irides pale yellow; the dorsal fin is placed behind the centre of gravity, but not so much so as in the common herring; the scales are smaller; the sides without any distinct lateral line; the edge of the belly carinated, but not serrated; the fins small. The fin-rays in number are—dorsal, 18; pectoral, 17; ventral, 9; anal, 16; and caudal, 20. Vertebræ, 54.

"The back and upper part of the sides are deep blue, with green reflections, passing into silvery-white beneath. The flesh of this species differs from that of the common herring in flavour, and is much more mild."

Mr. Yarrell first discovered this species when examining the various kinds of fishes caught by the fishermen engaged in taking sprats.

C. Sprattus, the Sprat, called in France Le Melet, Esprot, or Harenguet. This fish has by many authors been confounded with the young of the herring. It is however distinct, and its characters were first pointed out by Pennant; they are as follows:—proportions nearly the same as those of the herring, but the depth of the body is greater in proportion than in the young of that species; the gill-covers are not veined; the teeth of the lower jaw are so minute as to be scarcely visible to the touch. The dorsal fin is placed farther back, and the keel to the abdomen is more acutely serrated than in the herring.

Sprat-fishing commences in the early part of November; hence in season they immediately follow herrings, and the markets continue to be supplied with them during the winter months. Like the herrings these fishes inhabit the deep water during the summer: they are so plentiful as to be frequently used for manuring the land, and are often sold as low as 6*d.* per bushel.

C. alba (Yarrell), the White-Bait; French, Blanquette; German, Breitling. This fish has been supposed to be the young of the Shad. Mr. Yarrell however, upon a careful investigation of the subject, ascertained it to be a distinct species. Its distinguishing characters are:—Length of the head compared with that of the body, and not including the tail, as two to five; depth, as compared to the whole length of the fish, as one to five; keel of the abdomen distinctly serrated, but not so sharp as in the Shad. The dorsal fin commences half way between the tip of the muzzle and the end of the tail; the upper jaw is slightly crenated, the lower jaw is the longer, and is smooth. Its colour is silvery-white, growing greenish on the back; the body is more compressed than in the herring, and the keel to the abdomen is more sharply serrated than in either that fish or the sprat.

The White-Bait is caught in great abundance in the Thames as high up as Woolwich and Blackwall. The fishing commences about the beginning of April, and is continued to September. "When fishing as high as Woolwich," says Mr. Yarrell, "the tide must have flowed from three to four hours, and the water become sensibly brackish to the taste, before the White-Bait will be found to make their appearance. They return down the river with the first ebb-tide; and various attempts to preserve them in well-boats in pure fresh water have uniformly failed." The food of the White-Bait consists of small *Crustacea*. Dr. Parnell states that he has taken White-Bait in the Frith of Forth in considerable numbers during the summer months. It is also taken in the Ex and other rivers of England. When fried with flour it is a favourite dish with all classes of the community; and amongst the English few entertainments are more popular than White-Bait dinners. It is the young of the season that are taken in such large numbers in the Thames. The adult White-Bait are taken on the Kentish and Essex coasts throughout the winter.

C. Pilchardus, the Pilchard, Le Celan of the French. In size this fish resembles the herring; it is also nearly of the same form, but rather thicker, and of greater proportionate depth; the scales are larger, the head is shorter, the suboperculum is square, and the dorsal fin is more forward in position; the gill-covers are distinctly veined.

This fish is caught off the coast of Cornwall in great abundance; the fishing commences in July. The food of the Pilchard consists of small shrimps and other crustaceous animals.

C. alosa, Linnæus (*Alosa finta*, Cuvier), the Shad, is another fish belonging to this group. Cuvier separated this, together with several other species, from the true *Clupeæ*, from the circumstance of their having the upper jaw deeply notched in the middle.

Two species of Shad are found off the British coast; the first, the Twaite Shad of Yarrell, known generally by the name of Shad (*Alosa finta*), is about 14 inches in length; its colour is brownish-green on the back, or inclining to blue in certain lights; the rest of the body is silvery; five or six dusky spots are observed on each side, and are disposed longitudinally, the first close to the head, and the others at short intervals; the length of the head, as compared with the body, is as one to five; the body rather exceeds this measurement in depth; the jaws are furnished with distinct teeth, and the tail is deeply forked.

This fish is found in the Severn and Thames in tolerable abundance. The principal fishing season for the Shad in the Thames is about the second week of July. They begin to ascend the river about May for the purpose of depositing their spawn, and this being done they return to the sea about the end of July.

In former times the Shad was caught as high up the river as Putney; it now rarely passes London Bridge, and is caught in the greatest abundance a little below Greenwich. Its flesh is dry, and therefore not much esteemed for the table.

The second species of Shad, the Allice, or Allice Shad of Yarrell (*Alosa communis*), is considerably larger than the one just described, being from two to three feet in length: it may moreover be distinguished by its having only one spot on the side of the body, near the head, and that is sometimes scarcely visible: the jaws have no distinct teeth, and the scales of the body are rather smaller in proportion, though they are large in both species.

The Allice Shad is plentiful in the Severn, but of rather rare occurrence in the Thames.

C. encrasicolus (Linnæus), the Anchovy (*Engraulis encrasicolus*, Fleming; *Engraulis vulgaris*, Cuvier). This fish, which is a favourite condiment, is a native of the British seas. It has been taken in the river Dart; and Mr. Couch, in his 'Cornish Fauna,' says, "This fish abounds towards the end of summer, and if attention were paid to the fishery enough might be caught to supply the consumption of the British Islands. It is abundant on the coast of Wales:" and Mr. Yarrell says, "The Anchovy is reported to be at this time an inhabitant of the large piece of water below Blackwall called Dagenham Breach; and in May 1838 I received one that was caught in the Thames, where however this species is so little known that the specimen referred to was sent to me with a request to know what fish it was." [ANCHOVY.]

CLU'SIA, a genus of Plants belonging to the natural order *Clusiaceæ* or *Guttiferæ*, named after Charles de l'Ecluse, or Clusius, one of the most celebrated botanists of the 16th century. [CLUSIUS, CAROLUS, in BIOG. DIV.] It has a calyx of four imbricate coloured permanent sepals, the outer ones smallest, usually doubly bracteate at the base; the corolla of 4-6 deciduous petals; the stamens numerous and free in the male flowers; few, sterile, and connected in the female flowers; the style absent; the stigmas 5-12, radiately peltate, sessile, permanent; the flowers usually polygamous; the ovary surrounded by a short staminiferous nectary; the capsule fleshy, 5-12-celled, opening by valves from the top to the base, with a dissepiment in the middle of each valve; the placenta thick, triangular, central; the seeds egg-shaped, surrounded by pulp, suspended from the inner angle of the cells; the embryo straight, inverted; the cotyledons separable. This definition includes the genus *Quapoya* of Aublet. The species are trees and shrubs, usually parasitical, and yielding a vield resinous juice, of a balsamic flavour; hence they are called in England Balsam-Trees.

C. rosea, Rose-Flowered Balsam-Tree, has polygamous flowers, a rose-coloured 5-6-sepaled calyx; the tops of the dense nectaries awl-shaped; 8-12 stigmas; the leaves obovate, obtuse, veinless, sometimes emarginate, on short striated petioles. It is a native of the Carolinas and St. Domingo, and other parts of tropical America. The fruit is green, and of the size of an apple, with eight lines running like the meridians of a globe: when it ripens it opens at these lines, disclosing its scarlet seeds lying in the midst of a pulpy mucilaginous matter, similar to the pomegranate. The whole tree is very handsome, but few fruits offer so beautiful a piece of mechanism. "It grows on rocks, and frequently on the trunks and limbs of trees, occasioned by birds scattering or voiding the seeds, which being glutinous, like those of the mistletoe, take root in the same manner; but the roots not finding sufficient nutriment spread on the surface of the tree till they find a decayed hole or other lodgment wherein is some small portion of soil: the fertility of this being exhausted a root is discharged out of the hole till it reaches the ground, where it fixes itself, and the stem becomes a large tree." (Loudon.) The resin collected from this plant is used as an external application in veterinary medicine, and also is employed for covering boats instead of tallow and pitch.

C. alba has hermaphrodite flowers, a many-leaved calyx; corolla with 5-8 petals; tops of nectaries retuse, or with 5-10 short stamens;

Rose-Flowered Balsam-Tree (*Clusia rosea*).

1, an expanded flower; 2, a calyx seen from below; 3, the ovary, with a part of the calyx cut away; 4, a transverse section of a fruit.

stigmas 5-6; leaves like the preceding, but not emarginate. An elegant tree, native of South America, and epiphytical on larger trees. The trunk is frequently a foot in diameter. It abounds in a balsamic juice of a green colour, which becomes brown on being exposed to the air. The fruit is scarlet, and contains its seeds embedded in a scarlet pulp. Birds are very fond of the seeds, and pluck them out of the fruit while hanging on the tree. The Caribbees use the juice for painting the outside of their boats. The flowers are white, but not handsome.

C. Quapoya has stalked diœcious flowers; the calyx of 5 or 6 sepals; the corolla of 5 or 6 yellow petals; the nectary short, 4-5-lobed; stigmas 5; fruit globose; leaves obovate, acute. It is a native of the woods of Guyana, where it is called Quapoy. It is a climbing shrub with yellow flowers, and when cut into yields a white transparent juice. *C. panapanari* is a similar plant, yielding a yellow juice. *C. flava* is a tree closely resembling *C. alba*. *C. flava* is said by Endlicher to yield the Hog-Gum of Jamaica. The flowers of *C. insignis* weep a considerable quantity of resin from the disc and stamens. Von Martius says he obtained an ounce from two flowers.

All the species grow well in a light sandy loam, and cuttings root freely in sand under a hand-glass in heat. The pots in which the plants are grown require to be well drained with potsherds.

(Don, *Dichlamydeous Plants*; Loudon, *Encyclopædia of Plants*.)

CLUSIA'CEÆ, or GUTTIFERÆ, *Guttifers*, a small natural order of Exogenous Plants, inhabiting the hotter parts of tropical countries in both the Old and New World. They are readily known by their coriaceous opposite leaves, with very fine veins running parallel with each other in a gentle curve from the midrib to the margin; by the absence of stipules; their calyx composed of several sepals regularly overlapping each other, and bearing a definite proportion to the petals; their numerous stamens; and their superior ovary, which is in most cases many-celled and many-seeded, with a peltate radiant stigma. Their fruit is succulent, juicy, and in many cases resembling a large apple or orange. The Mangosteen (*Garcinia Mangostana*) is probably the most delicious of any known; but it has never been seen in a fresh state in Europe, for the tree will hardly exist out of its native humid heated atmosphere in the Indian Archipelago. The most remarkable product of this order is an acrid, purgative, yellow gum-resin. In one of its forms this is the Camboge or Gamboge of commerce. This substance is well known as a yellow pigment, as also a purgative medicine. The plant which yields the Gamboge of commerce is still unknown. The London College of Physicians in their 'Pharmacopœia' refer it to some species of *Garcinia*, others refer it to species of *Cambogia*, *Xanthochymus*, *Hebradendron*, and *Stalagmitis*. The East Indian Tacamahaca is yielded by a species of *Calophyllum*. [CALOPHYLLUM.] The Butter or Tallow-Tree of Sierra Leone is the *Pentadesma butyracea*. The fruits of many species are esteemed, besides the Mangosteen. The Mammee Apple, or Wild Apricot of South America, is said to be very delicious. Its seeds are anthelmintic; its flowers yield on distillation a spirit known as Eau de Creole, and wine is obtained by fermenting its sap. The large berries of the Pacouryuva (*Platonia insignis*) of Brazil are highly prized on account of their delicious flavour. The fruits of several species of *Garcinia* [GARCINIA], besides the Mangosteen, are brought to table in the countries where they grow, but they are regarded as very inferior. The blossoms of *Mesua ferrea* are remarkable for their fragrance, and are sold in the bazaars of India under the name of Nagkesur.

The affinities of the order *Clusiaceæ* are with *Hypericaceæ*, *Ternströmiaceæ*, and *Ebenaceæ*. The order contains 30 genera and 150 species.

(Lindley, *Vegetable Kingdom*.)

CLUTHALITE, a Mineral occurring in large nodules in amygdaloid, constituting a congeries of imperfect crystals with rough surfaces. Colour flesh-red. Hardness 3·5. Brittle. Lustre vitreous. Opaque or translucent on the edges only. Specific gravity 2·166. Found in the Kilpatrick Hills, near Dumbarton. An analysis by Dr. Thomson gives—

Silica	51·266
Alumina	23·560
Peroxide of Iron	7·306
Soda	5·130
Magnesia	1·233
Water	10·553

CLYMENIA. [CLYMENIDÆ.]

CLYMENIDÆ, a family of Fossil *Mollusca* belonging to D'Orbigny's order *Tentaculifera* of the class *Cephalopoda*. It embraces several genera, which are divided into groups according as their partitions are without or possess a single lateral lobe. To the first division, or those without lateral or dorsal lobes, belong the genera *Melia*, *Cameroceras*, *Campulites*, and *Trochilites*. To the second division, or those in which the partitions have one lateral lobe but no dorsal lobe, the genera *Clymenia* and *Megasiphonia* are referred.

The genus *Clymenia*, the type of this family, was first separated from the *Goniatites*, to which it has a strong resemblance, by Count Munster. The species of *Clymenia* have the variations of form and surface seen in *Goniatites*. [GONIATITES.] By some writers the *Clymenidæ* are referred to the *Nautilidæ*, with which they have no doubt a stronger affinity than with *Ammonitidæ*, the family to which *Goniatites* must be referred.

The genus *Clymenia* has a discoidal shell with slightly lobed septa, and an internal siphuncle. Several species were described by Count Munster from some calcareous bands in the Palæozoic strata of the Fichtelgeberge. Some of these, with others, occur in the strata of Devon and Cornwall, and also in North America.

CLYPEASTER. [ECHINIDÆ.]

CLY'PEUS, the generic name given by Klein and Leske to a group of Fossil *Echinidæ*, frequent in the Oolitic Formations. *C. sinuatus* of Leske is the largest British species. *C. clunicularis* of Smith is now ranked as a *Nucleolites*.

CLY'THRA, a genus of Coleopterous Insects of the family *Chrysomelidæ*. The insects of this genus generally have the body more or less cylindrical; the antennæ short, with the basal joint thick, the two following joints short, and the remaining (with the exception of the apical joint) serrated, that is, produced internally, so as to resemble the teeth of a saw. The head is placed vertically, and inserted into the thorax, so as to be scarcely visible from above; often larger in the male than the female. The legs are moderately long, rather thick; in the males the anterior pair are often considerably larger than the two posterior pairs; the penultimate joint of the tarsi is bilobed.

The larvæ of these insects (at least those that are known) inhabit a coriaceous tube, which they drag about with them.

The *Clythræ* reside on trees and shrubs, and those found in this country appear in the beginning of the summer. The species are very abundant, and seldom adorned with metallic colours. In England we have five species, the most common of which is *C. quadripunctata*. This is not quite half an inch in length, and black; the elytra ochre-coloured, with four black spots, two near the base, and two near the middle. The next species which is not uncommonly met with is *C. tridentata*. This beetle is rather less than the last, and of a blue-green colour, thickly and finely punctured above; the elytra are pale-yellow and immaculate; the anterior pair of legs in the male are elongated.

CLY'TUS, a genus of Coleopterous Insects of the section *Longicornes* and family *Cerambycidæ*.

The species of the genus *Clytus* (a genus established by Fabricius) form a well-marked group among the *Cerambycidæ*, and are chiefly distinguished by their having the palpi short and nearly equal, the terminal joint thicker than the others, and truncated at the apex; the head narrower than the thorax, and the latter nearly globular or approaching to a cylinder. The body is elongate, and nearly cylindrical; the antennæ are shorter than the body, and filiform; the basal joint is rather thick, and the terminal joints are sometimes incrassated; the legs are moderately long.

These insects are generally of moderate size, and have the elytra adorned with arcuated fasciæ; their ground colour is usually black or brown, and the markings yellow.

About 90 species of this genus have been discovered, and they appear to inhabit every quarter of the globe; 5 are recorded as British, of which the more common are *C. mysticus*, *C. Arietis*, and *C. arcuatus*. *C. mysticus* is about half an inch in length; colour black; the base of the elytra red-brown; three bent white fasciæ are situated near the middle of the elytra; and there is a white patch at the apex. This species is common in the neighbourhood of London. We have frequently found its larva in the rotten wood of old blackthorns.

C. Arietis is about the same size as the last; its colour is black; legs and base of the antennæ reddish; the former with the thighs of the two anterior pairs blackish; thorax with a yellow band on the anterior part, and another on the posterior; scutellum yellow; elytra with four yellow bands.

This insect is frequently met with in gardens and woods in the neighbourhood of London and elsewhere. When handled it makes a peculiar noise, which seems to be produced by the friction of the thorax against the smooth part of the abdomen which is inserted in that part. Many of the *Cerambycidæ* have this power.

C. arcuatus is less common than either of the preceding species; it somewhat resembles the *C. Arietis*, but is considerably larger and broader in proportion. The antennæ are entirely of a reddish-yellow colour, the legs are coloured as in the last-mentioned species; the thorax has a yellow band on the fore part, and an interrupted band in the middle; the elytra have three yellow bands, and towards the base three spots of the same colour; the scutellum is also yellow.

CNEMIDIUM, a genus of *Spongiadæ*, proposed by Goldfuss for some fossils usually ranked as *Mantellia* and *Siphonia*.

COAGULATION. [BLOOD.]

COAITA, or QUATA. [ATELES.]

COAITIMONDI. [VIVERRIDÆ.]

COAL, an opaque combustible mineral substance of a black or brown colour, and in all cases giving indications of having been derived from a vegetable source. Such is a definition that would probably include all those substances which are used in domestic economy and the arts for the purposes of combustion, and popularly called Coal. At the same time it should be stated that the term has at present no special scientific application that is universally admitted, and each investigator thinks himself at liberty to apply the term in accordance with his own views. As the knowledge of chemical principles and methods of investigation have advanced, substances which at one time were regarded as identical have been shown to have a very different chemical composition as well as microscopic structure. This has led in some instances to the discussion of the question, What is Coal?

For instance, in our courts of law, one of the most recent cases—that of Gillespie *v.* Russell—was tried in Edinburgh during the present year (1853). In this case, by an agreement for a lease entered into between the plaintiffs and defendants, the former agreed to grant to the latter a lease of "the whole coal, ironstone, iron-ore, limestone, and fire-clay, but not to comprehend copper or any other mineral whatsoever." It was alleged by the plaintiffs that, although the defendants had in the course of their operations come upon iron-ore and ironstone, coal, and fire clay of workable value, they had neglected these, and had chiefly worked a certain mineral substance which the plaintiffs contended was not let to the defendants, not being one of the mineral substances specified in the agreement. This mineral was of much greater value, it was stated, than any which the defendants were permitted to work. Although used as a combustible material, it was alleged that this substance was not coal, and that its chemical, microscopical, and mineralogical characters were not those of coal. On the other hand, it was asserted by the defendants that the mineral in question was coal; that they had been led to seek a lease of the Torbane-Hill estate from the fact that on the adjoining lands of Boghead this mineral existed, and was worked and sold as coal, being known in the markets by the name of the 'Boghead Gas Coal.' This mineral, they contended, was true coal belonging to the variety known as Cannel or Parrot Coal. This trial was interesting on account of the large number of chemists, mineralogists, geologists, and microscopists examined, who appeared in about equal numbers on either side; one set of them contending that the mineral was coal, whilst the others contended it was not. A large amount of interesting facts on the nature of coal and the substances with which it is found associated was laid before the jury, who came to the conclusion that, whatever might be the result of scientific investigation in more rigorously defining the nature of coal and limiting the use of that term, both plaintiffs and defendants called this mineral coal when the lease was drawn up, and therefore gave a verdict in favour of the defendants.

The same question which has thus been debated in Scotland has also come before the law courts of Germany and of the United States of America with the same differences of opinion; and we refer to these cases to show the difficulty of defining accurately this well-known substance. It may be regarded in the present state of our knowledge as one of those instances in which the typical form is lost by irregular combination with other and different substances.

That Coal is and must be of vegetable origin seems to be agreed upon by all inquirers, but the question of how to determine that origin in particular cases is the difficulty. Again, it is well known that coal after it is deposited undergoes certain chemical changes by which substances with a very definite chemical character are produced, such as bitumen, paraffine, &c. These, mixed with the coal itself and the earthy matters around, may form compound substances about whose nature there may be considerable difference of opinion. This is not improbably the case with the Torbane-Hill mineral, and will account for the peculiarity of both its chemical and microscopical characters.

Coal presents itself ordinarily in a massive form, and is brittle or sectile. It has a hardness of 2·5, and a specific gravity of 1·2 to 1·75. It is opaque, and has a black or brown colour. Its chemical composition is distinguished by the presence of carbon; in addition, it also yields, on ultimate analysis, hydrogen, oxygen, and nitrogen. On burning it leaves an ash which consists of varying quantities of silica, alumina, and oxide of iron. The carbon and hydrogen are often found chemically united to form bituminous compounds which are mixed with the coal. It is the presence of these compounds which causes coals to burn with a bright flame; at the same time they give off a bituminous odour. Those destitute of bituminous compounds burn with a pale blue flame, due to carbonic oxide, which is formed in these cases through the decomposition of the water present.

The following table, founded on Mr. Mushet's Analysis of Coal, is taken from Professor Ansted's 'Elementary Course of Geology, Mineralogy, and Physical Geography:'—

Analyses of various Kinds of Coal.

Locality.	Description of Coal.	Specific Gravity.	Carbon.	Bitumen Volatile Matter. Water.	Ash.
1. Newcastle-upon-Tyne	Bituminous	1·257	57·00	37·60	5·40
2. Lancashire	Ditto	1·260	54·90	40·48	4·62
3. Ditto	Cannel	—	56·40	41·00	2·60
4. North Wales	Bituminous	—	02·72	36·00	1·28
5. Staffordshire Potteries	Ditto	—	02·40	34·10	3·50
6. Yorkshire	Ditto	—	67·14	30·73	2·13
7. Ditto	Ditto	—	58·38	39·51	2·00
8. Derbyshire	Ditto	1 235	52·46	45·50	2·04
9. Ditto	Cannel	1·278	48·36	47·00	4·04
10. Ditto	Cherry	—	57·00	40·00	3·00
11. Shropshire	Bituminous	—	64·10	34·77	1·13
12. South Staffordshire	Ditto	—	54·05	42·70	3·25
13. Ditto	Ditto	—	54·17	43·33	2·50
14. Dean Forest	Ditto	—	63·72	32·03	4·25
15. South Wales	Ditto	—	60·25	33·00	6·75
16. Ditto	Ditto	—	66·02	29·15	2·83
17. Ditto	Ditto	—	70·68	25·82	3·50
18. Ditto	Anthracite	—	01·89	5·61	1·50
19. Ditto	Dry	—	79·50	17·50	3·00
20. Ditto	Steam	—	85·00	11·87	3·30
21. Clyde Valley	Bituminous	—	51·20	45·50	3·13
22. Lesmahago	Cannel	—	39·43	50·57	4·00
23. Scotch Coal (mean)	Dry	—	48·81	41·85	9·34
24. Ireland, Leinster	Dry Anthracite	1·602	92·88	4·25	2·87
25. Ditto ditto	Cannel	—	79·60	12·00	8·10
26. France (mean)	Dry	—	79·15	7·37	13·25
27. France, St.-Etienne	Bituminous	—	65·68	27·83	6·49
28. Spain (mean)	Ditto	—	53·00	40·00	7·00
29. Belgium, Hainault	Ditto	1·276	84·07	13·23	2·10
30. Belgium, Liège	Ditto	—	76·00	19·60	4·40
31. Ditto ditto	Dry	1·365	81·90	0·00	9·10
32. Silesia	Glance	—	58·17	37·89	8·03
33. Bengal	Slaty	1·447	41·00	36·00	23 00
34. America, Ohio	Bituminous	—	55·55	41·85	2·60
35. America, Alleghany	Dry	—	78·85	0·47	11·73
36. America, Nova Scotia	Bituminous	1·321	58 80	28·20	12·95
37. America, Pennsylvania	Anthracite	—	92·60	2·25	2·25

The following analyses of the Torbane-Hill Mineral and Cannel Coal were presented by Dr. Fyfe at the trial in Edinburgh:—

	Carb.	Hyd.	Oxy.	Nit.	Sulp.	Ash.
Torbane-Hill Mineral	60·25	8·8	3·6	1·5	9·3	25·6
Capeldrae Cannel Coal	56·7	0·8	8·8	1·9	0·25	25·4

The Torbane mineral is only remarkable amongst other coals for the large quantity of sulphur it contains.

A large series of coals, more especially Welsh, has been submitted to chemical examination by order of the government; and the following table is taken from the 'Report on the Coals suited to the Steam Navy,' by Sir Henry De la Beche and Dr. Lyon Playfair, in the second volume of the 'Memoirs of the Geological Survey of Great Britain:'—

Locality, or name of Coal.	Specific Gravity of Coal.	Carbon.	Hydrogen.	Nitrogen.	Sulphur.	Oxygen.	Ash.	Per Centage of Coal left in each.
Welsh Coals:—								
Graigola . . .	1·30	84·87	3·84	0·41	0·45	7·19	3·24	85·5
Anthracite . .	1·375	91·44	3·48	0·21	0·79	2·58	1·52	92·9
Oldcastle Fiery Vein	1·289	87·68	4·89	1·31	0·09	3·39	2·64	79·8
Ward's Fiery Vein .	1·344	87·87	3·93	2·02	0·83	Included in Ash	7·04	—
Burea Coal . .	1·304	88·86	4·63	1·43	0·33	1·03	3·96	88·10
Llangennech . .	1·312	85·48	4·20	1·07	0·29	2·44	8·54	83·80
Pentrepoth . .	1·31	88·72	4·50	0·18	—	3·24	3·36	82·5
Pentrefelin . .	1·358	85·52	3·72	trace	0·12	4·55	6·09	85·0
Duffryn . . .	1·326	88·26	4·66	1·45	1·77	0·66	3·28	84·3
Mynydd Newydd .	1·31	84·71	5·76	1·56	1·21	3·52	3·24	74·8
Three - quarter Rock Vein .	1·34	75·15	4·93	1·07	2·35	5·04	10·96	82·5
Cwm Frood Rock Vein . .	1·255	82·25	5·84	1·11	1·22	3·58	6·00	68·8
Cwm Nanty-gros .	1·23	78·36	5·59	1·88	3·01	5·58	5·60	85·6
Resolven . . .	1·32	79·33	4·75	1·38	5·07	Included in Ash	0·41	83·9
Ponty Pool . .	1·32	80·70	5·66	1·35	2·29	4·38	5·52	64·8
Bedwas . . .	1·32	80·61	6·01	1·44	3·50	1·50	6·94	71·7
Ebbw Vale . .	1·275	89·78	5·15	2·18	1·02	0·39	1·50	77·5
Porthmawr Rock Vein . .	1·39	74·70	4·70	1·28	0·91	3·60	14·72	63·1
Coleshill . . .	1·29	73·84	5·14	1·47	2·34	8·29	8·02	56·0
Scotch Coals:—								
Dalkeith Jewel Seam	1·277	74·55	5·14	0·10	0·33	15·51	4·37	49·8
Dalkeith Coronation Seam .	1·816	76·94	5·20	trace	0·33	14·37	3·10	53·5
Wallsend Elgin .	1·20	76·09	5·22	1·41	1·53	5·05	10·70	58·45
Fordel Splint . .	1·25	79·58	5·50	1·13	1·46	8·33	4·00	52·03
Grange Mouth . .	1·29	79·85	5·28	1·35	1·42	8·58	3·52	56·8
English Coals:—								
Broomhill . . .	1·25	81·70	6·17	1·84	2·85	4·37	3·07	59·2
Park End, Sydney .	1·283	73·52	5·69	2·04	2·27	8·48	10·00	57·8
Irish Coals:—								
Sievardagh . .	1·59	80·03	2·30	0·23	0·76	included in Ash	10·80	00·1
Foreign Coals:—								
Formosa Island .	1·24	78·26	5·70	0·64	0·49	10·95	3·06	—
Borneo (Labuan kind) . .	1·28	61·52	4·74	0·80	1·45	20·75	7·74	—
3 feet Seam .	1·37	54·31	5·03	0·98	1·14	24·22	14·32	—
11 feet Seam .	1·21	70·33	5·41	0·07	1·17	19·19	3·23	—
Patent Fuel:—								
Wylam's Patent Fuel	1·10	70·91	5·69	1·68	1·25	8·68	4·84	65·8
Bell's ditto .	1·14	87·88	5·22	0·81	0·71	0·42	4·98	71·7
Warlich's ditto .	1·15	90·02	5·56	trace	1·62	Included in Ash	2·01	85·1

Coal differs considerably in its physical properties, and it has obtained various names in the markets. The mineralogist generally divides it into two varieties:—

First, Coal without Bitumen.

Second, Coal with Bitumen.

The first variety is known by the general name of *Anthracite.* It has however various local names. [ANTHRACITE.] It is sometimes very hard, and has a high lustre, and is often iridescent. Besides being used for fuel it is often made into inkstands, small boxes, and other articles of use. This is more especially the case with the Anthracite of America. It is the most common form of coal in the Welsh beds.

The Bituminous varieties of Coal present greater differences of structure and appearance, and have a larger number of names. By the above analyses it will be seen that the quantity of Bitumen, or substances resembling it [BITUMEN], differ very much in different specimens of coal. It is generally softer and less lustrous than Anthracite, although occasionally specimens exhibit a very brilliant fracture. Its specific gravity is less than that of Anthracite, seldom exceeding 1·5, whilst the specific gravity of Anthracite ranges from 1·3 to 1·75. The kinds of this coal are known by various names.

The following are analyses of the different kinds of Coal as they occur in the Newcastle beds:—

	Splint Coal.	Caking Coal. No. 1.	Caking Coal. No. 2.	Cherry Coal.
Density	1·302	1·274	1·280	1·266
Carbon	74·061	83·588	87·809	84·694
Hydrogen	8·254	5·150	5·159	5·054
Nitrogen and Oxygen . .	4·673	8·743	5·139	8·476
Ash	13·012	2·591	1·393	1·576
Relative heat by the same weight of Coal	110·840	114·080	122·560	116·630
Relative heat by the same volume of Coal	108·090	111·310	119·030	112·070

Pitching or *Caking Coal* is known by its velvet or grayish-black colour. When first thrown on a fire it breaks into small pieces, but on the continued application of heat the pieces again unite into a solid mass or cake. It burns readily with a yellow flame, but on account of its caking quality it is likely to clog the fire unless it is frequently stirred. The Newcastle beds mostly yield this form of coal.

Cherry Coal resembles in external appearance the pitch coal, and when exposed to heat it cracks and flies, but does not cake. It is very brittle, and on this account much loss is occasioned in mining it. It burns with a clear yellow flame. This kind of coal occurs in the Glasgow beds.

Splint Coal is a variety found in connection with the last, and is remarkable for its hardness; for which reason it is sometimes called Hard Coal. It is also found at Glasgow.

Cannel Coal has little lustre, is very compact and smooth in its texture, and breaks with a large conchoidal fracture. It burns very readily, giving out a clear yellow flame without melting. In consequence it has been employed for the making of candles—hence its name. It is often employed for making inkstands, snuff-boxes, and other articles of use. At the Great Exhibition of 1851 several models of public buildings, monuments, &c., were exhibited, formed of Cannel Coal.

The above coals are those most commonly burned. Their goodness for heating is tested by the quantity of water they evaporate. The following are the results of some recent experiments:—

	lb.	oz.
Common Scotch Bituminous Coal . . .	5	14
Carr's West Hartley Main (Newcastle) . .	7	5
Merthyr Bituminous Coal	8	0
Pure Welch Anthracite	10	8½

From which it will be seen that the heating power of anthracite nearly doubles that of some bituminous coals.

Brown Coal, Wood Coal, Lignite, are names given to less perfect varieties of coal than the last. Specimens of these coals have a brownish-black colour, and burn with an empyreumatic odour.

On placing sections of Lignite under the microscope, the structure of the wood of the plant forming it can be readily detected. This is not the case with the other kinds of coal, where, although the woody fibre can be frequently made out, it has evidently undergone considerable change. Professor Quekett, on this ground, proposes to confine the term Coal to those fossil or mineral substances alone which are evidently made up of the woody tissue of plants. He maintained that the Torbane mineral was not coal, on the ground that it was not composed of the debris or remains of vegetable woody tissue. Although woody and vascular tissue can be seen in the Torbane mineral, Professor Quekett maintains that this has been accidentally introduced, and that no true vascular or spiral tissue is found in coal.

The term *Brown Coal* is frequently applied to coal more recently deposited than that of the great coal-beds of the world, and this quite independent of its structure or any peculiarity in combustion. *Lignite* is also a term applied to the semi-carbonised forms of wood which are frequently found in deposits later than those of the coal deposits. Most of these varieties of coal contain a large quantity of water, and the quantity of matter given off at a moderate heat by distillation is at least equal to that of the carbon contained.

"*Dysodil* is a yellow or grayish highly laminated substance, often found with lignite, and burning vividly, and spreading an odour of assafœtida." (Ansted.)

Jet is another variety of coal belonging to the bituminous series. It sometimes occurs in elongated reiform masses, and sometimes in the form of branches with a woody structure. It is soft and brittle, with a conchoidal fracture. Its specific gravity is but little greater than that of water. It is opaque, of a velvet-black colour, and has a brilliant and resinous lustre. It is found in Saxony, and also in the Prussian amber-mines in detached fragments. It is sometimes washed up on the shores of Great Britain. The finer sorts are used in the manufacture of ornaments and trinkets of various kinds. The coarser sorts are burned as fuel. It gives out when burned a greenish flame and a strong bituminous smell, and leaves a yellowish ash. It contains about 37½ per cent of volatile matter.

For an account of the origin of Coal, and the beds of Coal on the surface of the earth, see COAL FORMATION and COAL PLANTS.

(Dana, *Manual of Mineralogy*; Ansted, *Elementary Course of Geology, Mineralogy, and Physical Geography*; *Memoirs of the Geological Survey of Great Britain and of the Museum of Practical Geology*; Gregory, *Hand-Book of Organic Chemistry*; *Reports of Juries of Great Exhibition*; *Catalogue of the Great Exhibition*; *Proceedings of the Microscopical Society*; *Microscopical Journal*, 1854.)

COAL FORMATION. That part of the Carboniferous System of Rocks which lies above the Limestone Shale and Mountain Limestone is called the Coal Formation. The deposits constituting this formation consist of a series of alternating beds of sandstone and shales, between which lie beds or seams of coal. These deposits generally lie upon a rock called the Millstone Grit. The following is a synopsis of the Carboniferous System as it is developed in two of the most typical coal districts in the British Isles. These two districts are South Wales and Derbyshire.

In South Wales we get, resting on the Old Red-Sandstone, a band of about a hundred feet in thickness, of black fossiliferous shale, called the Lower Limestone Shale, over which are beds of thick limestone, called the Mountain or Carboniferous Limestone. The following is a synopsis of the whole formation, taken from the published sections of the 'Geological Survey of Britain' (ascending order):—

1. Lower Limestone Shale, about 100 feet.
2. Carboniferous Limestone; limestone, with occasional partings of black shale; from 500 to 1500 feet.

3. Millstone Grit, or Farewell Rock; white quartzose sandstone and conglomerate, 300 to 600 feet.

4. Coal-Measures; a great series of alternations of sandstones and shales, with occasional beds of coal; from 8000 to 12,000 feet in total maximum thickness.

In the Derbyshire district we get the following groups or series:—

1. Mountain Limestone; the base of which is not exposed, consisting principally of thick limestone, occasionally interstratified with black shales, and exceeding 1200 feet.

2. Limestone Shale; black shales, with their interstratified limestones; in some places 400 to 650 feet.

3. Millstone Grit; strong sandstones, with occasional small conglomerate, interstratified with shales and a few small beds of coal; about 1700 feet.

4. Coal-Measures; alternations of sandstone and shale, with beds of coal and ironstone; total thickness, 2700 feet and more.

Proceeding from the Derbyshire district towards the north, a gradual change takes place in the Carboniferous Formation in such a way that it becomes more and more a series of Coal-Measures from top to bottom. The Millstone Grit is never anything more than the lower part of the Coal-Measures in which beds of strong sandstone occur. These as we proceed north become more and more split up and interstratified by beds of shale and occasional beds of coal. The Limestone Shale, too, of Derbyshire farther north becomes split up by beds of gritstone and limestone, and still farther north by beds of coal. Lastly, the Mountain Limestone itself becomes split up and interstratified first by beds of shale, then by beds of shale and sandstone, and lastly, on the borders of Scotland, by shales, sandstones, and coals.

In the midland counties of England—namely, in Leicestershire, Warwickshire, Staffordshire, and Shropshire—the Carboniferous Formation consists simply of the upper group of the formation of the Coal-Measures. Little patches of Mountain Limestone are found below them in one or two spots in the first and last named counties; but usually the Coal-Measures rest directly and unconformably on Silurian and still older rocks. In Staffordshire several beds of coal come together by the thinning out of the intermediate measures, and make a mass of coal which in some places is upwards of 30 feet thick, in from 10 to 13 beds.

In Scotland the Carboniferous Formation admits of no subdivisions into groups. Immediately above the Old Red-Sandstone are Coal-Measures containing beds of coal, over which are thick encrinital limestones interstratified with shales, so that no single mass of limestone is more than 40 feet thick. The whole series of Carboniferous rocks in Scotland is said to be upwards of 6000 feet thick, the whole being Coal-Measures with interstratified beds of limestone in the lower portion, representing the Mountain Limestone of England. The whole series is composed of materials in the following proportions:—

	Feet.
Sandstone	3300
Shale	2160
Limestone	306
Coal	180
Clay	132
	6078

These materials are so disposed that there never is an unbroken set of beds of more than the following thickness of each sort:—

	Feet.
Sandstone	200
Shale	130
Limestone	40
Coal	13
Clay	28

Small bands and nodules of clay-ironstone are found occasionally in all the shales and clays of the Carboniferous rocks of England, Scotland, and Ireland; but though of economical value, they are not of great geological importance.

In Ireland the Carboniferous rocks consist in the south and west of two subdivisions—Carboniferous Limestone and Coal-Measures. The Carboniferous Limestone, the maximum thickness of which is about 3000 feet, is locally again subdivided into three parts—A. Lower Limestone. B. Calp, a series of dark limestones, interstratified with black shale. C. Upper Limestone. The Coal-Measures consist of alternations of shale and sandstone, with a few thin beds of coal principally anthracite or culm, and have a thickness of more than 2000 feet in the Queen's County. In the north of Ireland the Carboniferous rocks seem to assume more of the type of those of Yorkshire and the north of England. The Coal-Measures are still confined to the upper portion; but the lower part seems to consist of alternations of shale and sandstone with various thick beds of limestone, so that it may be doubted whether the subdivisions of the Carboniferous Limestone of the centre of Ireland can be accurately traced into the north or north-west.

The Carboniferous Formation of Belgium admits of a three-fold subdivision (ascending order):—

1. Arenaceous Shales; gray shales, limestones and pisolitic iron-ore, over which are gray sandstones and anthracite.

2. Limestone Group; cunoidal, dolomitic, and productus limestones, with chert and anthracite.

3. Coal-Measures; shale and sandstone, with coal.

The formation is found also at St.-Etienne in central France, where it appears to consist of conglomerate and sandstone below, and shale and sandstone above, with beds of coal.

In Westphalia there are black shales below, passing up into black limestones, and those into lighter-coloured limestone, which are covered by black shales and sandstone in which beds of coal occur.

In Russia there are, according to Sir R. Murchison, two types of the formation. The northern type consists of (ascending order):—

1. Sands and Shales with coal.

2. Dark-Gray Productus Limestone, Yellow Magnesian Limestone, White Limestone of Moscow, shale and sandstone, and gray, white, and yellow limestone.

3. Limestones, calcareous grits, and flagstones capped by conglomerate.

In this type the coal is confined to the base of the formation.

The southern type consists of:—

1. Sands and Shales without coal.

2. Productus Limestone with shales, sandstones, and thin limestones, with many beds of coal.

3. Limestone, calcareous grits, and flagstones, with traces of coal, capped by sandstone containing coal plants.

In this type the most coal occurs about the centre of the formation.

The above remarks, taken from Mr. Jukes's admirable 'Introduction to Physical Geology,' will serve to show the relation of the deposits of Coal to the other rocks and substances with which it is found associated. The Coal-Measures above referred to occupy definite and limited areas of somewhat considerable extent in various parts of Europe, Asia, America, and the islands adjacent. The following is an estimate of the annual production of coals in various parts of the world as given by Professor Ansted:—

Countries.	Coal Area in Square Miles	Proportion to Area.	Total Yearly Production in Tons.
British Islands	12,000	1— 10	32,000,000
France	2,000	1—100	4,150,000
Belgium	520	1— 22	5,000,000
Spain	4,000	1— 52	550,000
Prussia	1,200	1— 90	3,500,000
Bohemia	1,000	1— 20	—
United States of America	113,000	1— 20	4,000,000
British North America	18,000	2— 9	(?)

Table of the Principal Coal-Fields of the British Islands. From Professor Ansted.

COAL-FIELDS.	Estimated workable area in acres.	Number of workable seams.	Estimated total thickness of workable Coal in feet.	Thickest bed in feet.	Thickness of Coal-bearing measures in feet.
1. Northumberland and Durham District.					
Newcastle Coal-Field	500,000	18	80	7	—
2. Cumberland, Westmoreland, and West Riding of Yorkshire:—					
Whitehaven and Akerton	80,000	17	—	8	2,000
Appleby (3 basins)	17,000	—	—	—	—
Sebergham (Cumberland)	(?)	1	3	3	—
Kirby Lonsdale	2,500	4	17	9	—
3. Lancashire, Flintshire, and North Staffordshire:—					
Lancashire Coal-Field	380,000	75	150	10	6,000
Flintshire	120,000	5	39	0	200
Pottery, North Staffordshire	40,000	24	38	10	—
Cheadle, North Staffordshire	10,000	—	—	—	—
4. Yorkshire, Nottinghamshire, and Derbyshire:—					
Great Yorkshire Coal-Field	650,000	12	32	10	—
Darley Moor, Derbyshire; Shirley Moor, Derbyshire	1,500	—	—	—	—
5. Shropshire and Worcestershire:—					
Colebrook Dale, Shropshire	21,000	17	40	—	—
Shrewsbury, Shropshire	10,000	3	—	—	—
Brown Clee Hill, Shropshire	1,300	3	—	—	—
Titterstone Clee Hill, Shropshire	5,000	—	—	—	—
Lukey Hill, Worcestershire	650	(?)	(?)	(?)	—
Bewdley, Worcestershire	45,000	(?)	—	—	—
6. South Staffordshire:—					
Dudley and Wolverhampton	65,000	11	67	40	1,000
7. Warwickshire and Leicestershire:—					
Nuneaton	40,000	9	30	15	—
Ashby-de-la-Zouch	40,000	5	33	21	—
8. Somersetshire and Gloucestershire:—					
Bristol	130,000	50	90	—	—
Forest of Dean	30,000	37	17	—	—
Newent, Gloucestershire	1,500	15	4	7	—

(*Table continued*)

COAL-FIELDS.	Estimated workable area in acres.	Number of workable seams.	Estimated total thickness of workable Coal in feet.	Thickest bed in feet.	Thickness of Coal-bearing measures in feet.
9. South Welch Coal-Field . . .	600,000	30	100	9	12,000
10. Scottish Coal-Fields :—					
Clyde Valley, Lanarkshire, South of Scotland several small areas .	1,000,000	84	200(?)	13	6,000
Mid Lothian	(?)	24	94	—	4,400
East Lothian	(?)	60	180	13	6,000
Kilmarnock, Ayrshire . . .	(?)	3	40	30	—
Fifeshire	(?)	(?)	(?)	21	—
Dumfries Coal region . . .	45,000	10	55	6	—
11. Irish Coal-Fields :—					
Ulster	500,000	9	40(?)	6	—
Connaught	200,000	—	—	—	—
Leinster, Kilkenny . . .	150,000	8	23	—	—
Munster, several	1,000,000	—	—	—	—

The following arrangement is that of Messrs. Conybeare and Phillips, and from its simplicity will serve as a plan for some general remarks on the coal-fields of Great Britain:—1. The great northern district, including all the coal-fields north of the Trent. 2. The central district, including Leicester, Warwick, Stafford, and Shropshire. 3. The western district, which may be subdivided into north-western, including North Wales; and south-western, including South Wales, Gloucester, and Somersetshire.

Coal-District North of the Trent.—This great coal formation encircles the whole Penine mountain chain on the east, south, and north; not however in one uninterrupted line, but in a series of detached coal-fields. 1. The Coal-Field of Northumberland and Durham. 2. Some small detached Coal-Fields in the North of Yorkshire. 3. The Coal-Field of South Yorkshire, Nottingham, and Derby. 4. The Coal-Field of North Stafford. 5. The South Lancashire Coal-Field. 6. The North Lancashire Coal-Field. 7. The Whitehaven Coal-Field.

1. The Coal-Field of Northumberland and Durham commences near the mouth of the river Coqnet on the north, and extends nearly to the Tees on the south. As far as Shields the sea is its boundary on the east; from that point it leaves a margin of a few miles between it and the sea, and extends about 10 miles west from Newcastle. Its greatest length is 58 miles, and its greatest breadth about 24 miles. The coal-measures of this field rest on the series of strata of the millstone grit and shale, and are in part under the magnesian limestone, the northernmost point of which is near the mouth of the Tyne. The beds of which this coal formation is composed dip towards the east and crop out towards the west, so that a section of them gives the idea of a form of a boat. In consequence of this disposition the beds of coal in some places appear at the surface, while in the middle of the basin they are at great depths. At Yarrow, about five miles from the mouth of the Tyne, one of the thickest beds, called the High Main, is 960 feet deep, and rises on all sides; the dip of the strata averages one inch in twenty, but this is not uniform throughout; and therefore that bed does not rise to the surface at equal distances around Yarrow. The beds of the coal-measures are 82 in number, and consist of alternating beds of coal, sandstone, and slate-clay; making an aggregate thickness of 1620 feet, which varies however in different parts. The irregularities of the surface do not affect the dip or inclination of the strata; so that when a valley intervenes they are found in the sides of the opposite hills at the same levels as if the respective strata had once been continuous. It is difficult to determine the exact number of beds of coal, in consequence of the different depths at which the same bed occurs, the numerous faults, and the varying thickness of the beds of coal and other strata. These strata occasionally enlarge and contract so much, that it is only by extensive observation that the identity of the seams can be ascertained. Dr. Thomson supposes the whole number of beds of coal in this field to be twenty-five; Messrs. Conybeare and Phillips state that forty beds of coal have been seen: a considerable number however of these are very thin. The two most important beds are those distinguished by the names of High Main and Low Main. The thickness of the first is 6 feet, and of the second 6 feet 6 inches. The Low Main is about 60 fathoms below the High Main. Eight other beds of coal occur between these: one called Bensham is 4 feet thick, and another called Coal-Yard is 3 feet thick. Seven beds of coal have been observed under the Low Main, some of which are of considerable thickness, but of an inferior quality. The aggregate thickness of the whole number of seams is about 44 feet; but there are eleven beds not workable, the thickness of some of them being only a few inches. Five others amount together to only 6 feet. Making proper deductions for these, it may be considered that the available beds amount to 30 feet in thickness.

The number of dykes or faults which traverse this field is very considerable. They appear to run in all directions. The most remarkable, called the Great Dyke, or 90-fathom dyke, has received the latter name because the beds on the north side of it have been thrown down 90 fathoms. Its direction is north-north-east and south-south-west. It enters the sea a little to the south of Hartley, or about three miles north of Shields, and running westward crosses the Tyne at Lemington, about four miles west of Newcastle Bridge. In some places it is only a few inches wide, but in Montagu colliery it is 22 yards wide, and is filled with hard and soft sandstone. From the southern side of this dyke two others branch off, one to the south-east and the other to the south-west. The latter, called from its breadth the 70-yard dyke, is also filled with hard and soft sandstone. This dyke intersects the upper or Beaumont seam of coal, but does not alter the level on either side. The thickness of the seam however decreases, beginning at the distance of 15 or 16 yards from the dyke: and the coal first becomes sooty, and at length assumes the appearance of coke. The south-eastern branch is only 20 yards in breadth. Another dyke, which passes through Coaley Hill, about four miles west of Newcastle, is about 24 feet wide. It is filled with basalt in detached masses, which are coated with yellow ochre; a thin layer of indurated clay is interposed between the sides of the fissure and the basalt. The upper seam of coal is here about 35 feet from the surface, and where it is in contact with the dyke is completely charred. Another dyke, which crosses the Tyne at Walker, and traverses the Walker colliery, does not alter the level of the strata, but on each side of it the coal is converted into coke, which on one side in some places was found to be 18 feet thick, and on the opposite side only about 9 feet. At Walbottle Dean, 5½ miles west of Newcastle, a double vein of basalt crosses the ravine in a diagonal direction, passing nearly due east and west; it underlies at an angle of 78 degrees, and cuts the coal strata without altering their dip, but the seam of coal is charred. A dyke, called the Cockfield Dyke, 17 feet wide, throws up the coal-measures on the south 18 feet. The Low Main coal, contiguous to the basalt, is only 9 inches thick, but enlarges to 6 feet at the distance of 150 feet from it; the coal contiguous to the dyke is reduced to a cinder. The dykes, if not large, are locally called *troubles*, *slips*, or *hitches*. These minor faults are numerous and extensive, and are a perpetual source of difficulty and expense to the coal-owner by disturbing the level of the strata and by the disengagement of carburetted hydrogen gas. They are not however without their use, being often filled with a tenacious water-proof clay, by which numerous springs are dammed up and brought to the surface. The faults which depress the strata have kept valuable seams within the basin, which would otherwise have cropped out and have been lost.

The coal-field of Northumberland and Durham supplies an enormous quantity of coal. Besides being consumed in its own district, London depends nearly altogether on it, as well as all the southern coast counties, with the exception of Cornwall. It is consumed along the eastern coast, including all the eastern counties as far west as Hull, Boston, Peterborough, Bedford, and Windsor. An inquiry as to the probable duration of this supply is one of no small interest. Dr. Thomson calculates that this coal-field may fairly be expected to yield coal for 1000 years, at the annual consumption of two millions of chaldrons; but as we have no data by which to discover how much coal has been already consumed, we cannot tell how much of these 1000 years has already elapsed. Besides this, Dr. Thomson has taken the average annual consumption much too low for the present time. The coals shipped from the Tyne, the Wear, and the Tees, in 1835, amounted to 4,368,144 tons. The quantity of waste coal is estimated at one-third of the whole. Without therefore taking into account the consumption of the immediate district, the annual quantity of coal taken from the mines is more than 6,552,216 tons.

On the other hand it appears that in this calculation the area of the coal-field is very much under-estimated, being taken at 180 square miles. Professor Buckland, in his examination before the House of Commons, limits the period of supply at the present rate of consumption to about 400 years. Mr. Baily, in his 'Survey of Durham,' states the period for the exhaustion of the coal to be about 200 years hence. Some proprietors of the coal-mines, when examined before the House of Commons, in 1830, extended the period of exhaustion to 1727 years. They assumed that there are 837 square miles of coal strata in this field, and that only 105 miles had been worked out. The small coal taken out of the pits is not considered worth shipment; large quantities of it were therefore often piled up near the mouths of the pits. These masses of coal were frequently set on fire, and burned for several years. Dr. Thomson describes two of these immense fires which were burning in 1814. About three miles to the north of Newcastle, and three miles off the road from Berwick, on the left hand, "one has been burning these eight years. The heap of coal is said to cover twelve acres. The other, on the right hand, is nearer the road and therefore appears more bright: it has been burning these three or four years (1814)." Of late years many more manufactories have been established in this district, by which, and by converting it into coke, most of the small coal is consumed.

Besides this coal-field there is another coal formation in the northern counties, which is minutely described by Dr. Thomson in the 'Annals of Philosophy,' November, 1814, under the name of the Independent Coal Formation. This tract terminates westward at Cross Fell, in Cumberland, is supposed to occupy the whole of Durham, and constitutes the whole of that part of Northumberland east of the Cheviots exclusive of the coal-field already described. The different strata of this coal formation amount to about 147. The coal-measures here differ from those we have just noticed, in having limestone as well as sandstone and slate-clay alternating with the beds of coal; the coal worked in this formation is slate-coal, and is considered inferior in quality to the Newcastle coal. There are several collieries, but the coal is only employed for home consumption. The lowest bed of these measures crops out near Cross Fell. The coal of which it is composed, provincially called crow-coal, falls into powder when exposed to the air, and cannot be burnt by itself. The poorer class make it up into balls with clay, and use it for fuel. This bed is 387 fathoms below the lowest of the Newcastle beds. ('Ann. of Phil.,' vol. iv.) There are numerous lead mines in this tract.

2. Detached Coal-Fields in the North of Yorkshire.—These are very limited in extent, being small insulated coal basins, lying in hollows in the gritstone. They occur near Middleham, Leyburne, Thorpefell, near Burnsell, and as far west as Kettlewell. The seam is seldom more than 20 inches thick. At Thedswell Moor the lowest seam is one yard, but the stratum diminishes and vanishes at the edges. Messrs. Conybeare and Phillips doubt whether these beds should not be referred to the thin coal seams subordinate to the millstone grit series, rather than to the principal coal-measures.

Coal is wrought in some parts of the great carboniferous chain extending from Penigent to Kirkby Stephen. Here the great 'Craven fault' occurs, described by Professor Sedgwick ('On the Carboniferous Chain from Penigent to Kirkby Stephen,' in 'Geol. Trans.,' vol. iv. series 2) as ranging along the line of junction of the central chain with the skirts of the Cumbrian system, passing along the south flank of Casterton Low Fell, up Barbondale, thence across the valley of Dent through the upper part of the valley of Sedbergh, and along the flanks of Bowe Fell, and Wildboar Fell, to the ridge which flanks Ravenstone Dale. Throughout the whole of this line there are enormous and most complex dislocations, which affect the strata of the coal formation and produce other phenomena. Only one of the coal strata in the lowest part of the coal-measures is sufficiently valuable to be worked; it varies from 18 inches to nearly 4 feet in thickness. At Turns Fell, near Hawes, in Yorkshire and at Tan Hill, near the highest part of the road from Brough to Argengarthdale, this coal is extensively worked, and is of good quality. The same seam is found near Kirkby Stephen. Horizontal drifts have been carried into this bed near the top of Penigent, of Whernside, and of Great Colm; but in these parts it is of bad quality and not fit for domestic use, being mixed with ferruginous and pyritous shale. This coal varies in thickness from a mere trace to 2 feet. It was once worked to some extent on the south side of the valley of Dent, by means of horizontal drifts under Great Colm. It was only a few inches in thickness, but said to be of so good a quality as to be in great request. About 70 or 80 years ago it was sent on pack-horses from this place as far as Kendal, for the use of blacksmiths' forges, &c. Kendal has long been supplied with fuel from the Lancashire coal-field; but this fact, of comparatively so recent a date, strongly illustrates the astonishing progress we have made in our modes of internal communication.

At the Barbon coal-pit in Westmoreland, a coal bed of this series is likewise wrought; the lower part of it is however so impure as to be unfit for ordinary purposes, and is chiefly consumed in lime-works. The following is a section of the strata as occurring in the Barbon colliery.—

	feet.	in.
1. Alluvial Soil	52	6
2. Plate (Calcareous Shale)	1	6
3. Limestone, the 4th or Mosdale Moor Limestone of the great section	27	0
4. Gritstone	27	0
5. Alternations of Shale and Gritstone	12	0
6. Shale	30	0
7. Crow Limestone	2	0
8. Plate with a 3-inch Crow-Coal	1	6
9. Gritstone	27	0
10. Coal	1	2

The strata of the coal are in general much less regularly continuous than the strata of limestone. This however is not always the case. Some of the thin bands of coal here appear to continue with astonishing regularity. The following example is quoted from Professor Sedgwick. "At Cross Pits, in the valley of Dent, the coal seam under the 12-fathom limestone is divided, by a band of clay half an inch thick, into two parts, with distinct mineral characters; and the same coal seam, with exactly the same subdivisions, has been found in the mountain on the opposite side of the valley at the distance of 3 or 4 miles measured in a straight line. This seems to prove that a bed not more than a fraction of an inch thick was originally continuous throughout an area probably several miles in diameter." ('Geol. Trans.' vol. iv. sec. 2, p. 101.)

3. Coal-Field of South Yorkshire, Nottingham, and Derbyshire.—This extensive field, which in character is closely allied to that of Newcastle, is considered by some geologists as a re-emergence of the same strata from beneath the covering of magnesian limestone under which it is concealed through the intervening space. This coal-field occupies an area extending north and south from a little to the north-east of Leeds nearly to Derby, a distance of more than 65 miles; its greatest width, 23 miles, is on the north, reaching nearly as far as Halifax to the west. On the south it extends towards the east to Nottingham, and is here about 12 miles wide; but in some parts it is much narrower. The strata of these coal measures range in the same manner as in the Northumberland coal-field, from north to south, dip to the east and rise to the west and north-west, in which directions the lowest measures at length crop out against the rocks of the millstone-grit series, which constitute the higher ridges of the Penine chain. The strata of this coal formation are very numerous. There are 20 beds of gritstone at the least, some of great thickness. Most of these beds consist of grains of semi-transparent silex united by an argillaceous cement; the lowest of these beds is termed the millstone grit, beneath which no workable coal is found. Besides these gritstone beds there are numerous strata of shale (slate-clay), bind (indurated loam), and clunch (indurated clay), alternating with several beds of coal of different thickness and value. A hard argillaceous rock called crow-stone forms in some places the floor of the coal beds, and is supposed to be a variety of the clunch still more highly indurated. The numerous faults in this coal-field render it extremely difficult to ascertain the exact number and order of the coal beds. Mr. Bakewell (p. 384) states their number at 30, varying from 6 inches to 11 feet, and the total thickness of coal at 26 yards. This however he considers as only an approximation. Three varieties of coal occur in these measures: hard, or stone-coal, which burns to a white ash; soft, or bright, which burns to a white ash; caking, or crozling, which usually burns to a red ash. The first is esteemed the best, and is in much greater demand than the others. The thickest bed is worked near Barnsby. In a pit near Middleton three seams are being worked; one at the depth of about 40 to 70 yards from the surface, another 38 yards lower, and the deepest from 28 to 32 yards deeper, making the whole depth from 106 to 140 yards. The upper seam is about 2 feet 8 inches thick, the middle seam from 2 feet 10 inches to 3 feet 4 inches, and the lower one from 4 feet 6 inches to 5 feet.

The strata of this field are traversed by an immense fault commencing from Allestry, in the south, and running in a zigzag direction through the south and east part of the field; the rise of the strata is said to be much more rapid on the western than the eastern side of the fault. Besides this great fault there are many others which traverse the field in various directions, and create an inextricable confusion by the rise and fall of the different strata, rendering it almost impossible to trace distinctly the continuation of each bed. This coal-field supplies the coal for the important manufactures which surround it, and also, by means of inland navigation, the midland counties south and east of Derbyshire.

A little to the west of the coal-field already described, coal has been found in two places about half-way between Ashborne and Derby, but it has not been worked.

4. Coal-Field of North Stafford.—There are two detached coal-fields: the one situated on the north-east of Newcastle-under-Lyne, distinguished as the Pottery Coal-Field; the other at Cheadle, to the east of the first. The form of the Pottery Coal-Field is triangular. Its vertex is near Congleton, from which point the sides diverge to the south-south-east and south-south-west, running in each direction about ten miles; the base is estimated at about seven miles: Newcastle is nearly in the centre of the base. The strata dip from the two sides to the centre of the area. On the eastern side the inclination westward is estimated at one foot in four; on the other side it is still more rapid. Between Burslem and its eastern limit, nearly in the centre of the coal-field, it has been ascertained that there are 32 beds of coal of various thickness, generally from about 3 to 10 feet each; but the strata are in general much dislocated in this field.

In the principal mines in this district coal is found at various depths, from 50 to 300 yards and more; there has been a mine worked at the depth of more than 400 yards. Some seams only 20 inches thick have occasionally been worked, but they are seldom worked under 3 or 4 feet thickness.

The Cheadle Coal-Field is an insulated basin surrounded by and reposing upon millstone grit; it is about five miles long and three miles broad, and is of little importance.

5. The Manchester or South-Lancashire Coal-Field is separated from that of South Yorkshire and Derbyshire by the range of lofty hills extending from near Colne to Blackstone Edge, and thence to Ax Edge in Derbyshire. It commences near the western side of this range in the north-west of Derbyshire, and continues thence to the south-western part of Lancashire, forming an area somewhat in the shape of a crescent, having Manchester nearly in the centre. The chord or span between the opposite horns is about forty miles. It runs nearly due north from Macclesfield to a few miles beyond Rochdale, a distance of thirty miles; the part between Macclesfield and Manchester is however very narrow, being in some places not two miles in width. From Rochdale it extends westward to Bolton and Chorley, south-west to Leigh and Prescot, north-west to Preston, and north to Colne. Viewing it as a whole, the strata rise towards the exterior edge of this crescent-shaped coal-field, along which the strata of millstone grit, on which they repose, crop out from beneath them, and dip towards its inner edge, where they are covered by the superior strata of the newer sandstone formation, which contain occasionally

beds of calcareo-magnesian conglomerate. Great disturbances have however interrupted the regularity of this arrangement, and caused divisions of the coal-measures, which render it difficult to trace out the exact dimensions of the field. At Disley, in Cheshire, it bifurcates into two branches, having an intermediate ridge or "saddle of millstone grit, the eastern branch forming a trough, of which the strata crop out on both sides against the millstone grit." This part of the field is a long narrow strip joined to the main field at Disley, and extending thence southward fifteen miles to near Mearbrooke in Staffordshire. The strata of the western branch of this bifurcation, extending from Disley to Macclesfield, dip again to the west, but not at so great an angle as they rose, on the east side of the intermediate ridge. In other parts of the coal-field great faults occur, but it has not been sufficiently investigated by the geologist for them to be distinctly traced. Mr. Bakewell has investigated a small portion, which he distinguishes as the Coal-Field of Bradford: the result of his observations is found in the second volume of the 'Geological Transactions.' This tract is rather more than two miles long, and little more than one mile and a furlong wide. It is situated on the river Medlock, a short distance east-south-east of Manchester. It is surrounded on every side, except the east, by the red-sandstone which prevails in the environs of Manchester. Beds of limestone pass under this and overlay the coal-measures, in which there are several beds of coal rising to the north, under an angle of 30°. One of these, near the centre of the field, is four feet in thickness. To the north of these inclined beds there is a considerable disturbance, and the direction of the beds becomes suddenly vertical. One of the vertical beds, together with its accompanying strata, bears so close a resemblance to the 4-feet coal above mentioned, that there is no doubt of their identity, and that the vertical stratum was, before the dislocation which severed them took place, a continuation of the first. With these vertical beds the coal-measures terminate: on the north an interval of the red-sandstone succeeds for about 1400 yards, when coal-beds again appear, rising as before towards the north. All this indicates considerable faults and subsidences, which however cannot be accurately traced at present. The coal from the Lancashire field supplies Manchester, Liverpool, and the surrounding districts.

6. The North Lancashire Coal-Field is one of little importance. It lies midway between Lancaster and Ingleton; it is about eight miles long and six miles wide, but it has never been thoroughly examined, and its strata cannot be distinctly stated.

7. The Whitehaven Coal-Field is situated on the west coast of Cumberland, and extends from near Egremont, south of Whitehaven, to near Allonby on the north.

Central Coal District.—Under this division are classed the coal-fields of Ashby-de-la-Zouch, of Warwickshire, and South Staffordshire.

1. The Coal-Field of Ashby-de-la-Zouch is of a very irregular figure, and so much dislocated that it rather forms two small basins than one continuous whole. The greatest length from north-west to south-east is about ten miles, the greatest breadth about eight miles. The eastern extremity of this area approaches almost close to the transition district of Charnwood Forest. This coal-field is described by Mr. Farey as "one of the highly curious but perhaps not uncommon occurrences in the red marl districts; a tract entirely surrounded by a fault, or a series of faults, which unite, seem lifted up through the red marl strata, and denudated, the coal strata having rapid dips in various directions, while the surrounding strata of red marl are horizontal, or as nearly so as may be." Of the two portions of the field, one ranges by Ashby Wold, about three miles on the west of Ashby; the other by Cole Orton, which is about the same distance on the east.

The Ashby Wold portion ranges from Swepston, four miles south of Ashby, to Brethy in Derbyshire: the inclination of the strata is towards Ashby; but between the out-crop of the beds and that town another crop has been traced near Brothorpe, dipping in a contrary direction. More than twenty coal-works have been opened on this line. The lowest shaft sunk is to the depth of 246 yards. One of the seams is from 17 to 21 feet thick. This great thickness is caused, it is supposed, by the running together of two or more seams—a circumstance which is known to occur in the coal-fields of South Staffordshire. The eastern portion of this district commences about a mile and a half north-east of Ashby, and extends about six miles in length, running parallel to the larger portion. The strata dip to east-north-east. In the pits belonging to Sir George Beaumont two coal-beds, each a yard and a half thick, are worked. On Cole Orton Moor several coal-seams, which have been proved to lie above these, have been worked at the depth of 116 feet.

2. The Warwickshire Coal-Field commences at Wyken and Sow, two villages about three miles east of Coventry, and continues in a north-west direction to Polesworth and Warcston, about five miles east of Tamworth, a distance of sixteen miles: its average breadth is about three miles. All the strata rise to the east-north-east, the inclination becoming greater towards the eastern edge of the field, where in many parts it makes an angle of more than 45° with the horizon: towards the west it decreases to about one foot in three, and lastly in five. The principal collieries are near the south of the field, at Griff and Bedworth. The depth of the first is 117 yards, and the principal seam three yards in thickness. The same seams are worked in the Bedworth mines, but there the first and second coal-seams of Griff run together and form a 5-yard seam. The intermediate strata of shale which separate them at Griff are found in the eastern shaft to be 33 yards, and in the western 25 yards thick; but they gradually decrease as they proceed westward, till at length they entirely vanish.

3. South Staffordshire or Dudley Coal-Field, the principal in the central district, extends from Beverton, near Badgely, on the north-east, to near Stourbridge on the south-west. The greatest length is about twenty miles, and its greatest breadth, from Walsall to Wolverhampton, is about seven miles, but it is very irregular towards the south, being almost divided into two parts. The area, from actual survey, has been found to be about sixty square miles. The southern portion, extending from Stourbridge to Bilston, about seven or eight miles in length and four in breadth, has been fully investigated by Mr. Keirs, and described by him in Shaw's 'History of Staffordshire.' No satisfactory account of the northern portions of this field has hitherto been published; many coal-seams, of eight, six, and four feet in thickness, are worked in it. The southern portion is of much more importance, as it contains seams from 30 to 45 feet in thickness. This enormous thickness is however not one continuous seam, but a number of seams, divided by layers of what the miners call band, which are very thin beds of clay-slate. The working of these thick seams is not so profitable as might be supposed. The pillars left standing in order to support the high roof are estimated at about one-third of the whole coal in the bed, and the small coal left in the mine is about equal to another third, so that only one-third of the whole is at present taken out of the mine.

In the coal-measures of this district there is an absence of the millstone grit, carboniferous limestone, and old red-sandstone, which usually lie under the coal-measures. The coal-measures rest, in the Dudley Coal-Field, on the transition rock at once, without any intermediate strata: this singularity is likewise observed in the Coalbrook Dale coal formation.

The coal district in South Staffordshire is traversed from north-west to south-east by apparently a line of hills, but they are not absolutely continuous, though they have a uniform general direction. On examination, the hills on the north and those on the south of Dudley are found to differ entirely in their character. The northern chain consists of highly inclined strata of limestone, against the sides of which all the coal-measures crop out at a considerable angle, but come nearer a horizontal position as they recede from these hills. The other chain of hills, on the south of Dudley, is entirely composed of one mass of basalt and amygdaloid, and the coal-measures preserve their usual level in approaching the hills, not cropping out as they do upon the limestone chain. Two opinions are entertained with regard to these basalt elevations: "they may be either the protruding edge of a vast basaltic dyke traversing the coal-field, or an overlying mass:" the latter is considered the more probable. The coal-measures on the south, near Stourbridge, appear to dip beneath the beds of the newer red-sandstone formation: the beds of this and of the Warwickshire coal-field dipping in opposite directions under the super-strata, give reason for supposing that they may extend continuously below this through the intervening space. The eastern side of the field, which extends a little beyond Walsall, is bounded by the same limestone with that of Dudley, and the coal-measures are observed again to crop out against it, thus lying in a basin between these two towns. That the coal-beds rise towards the north, and the upper ones crop out while others continue under the surface, is very satisfactorily shown by the comparison of the strata in different collieries. At Tividale the main coal is $60\frac{1}{2}$ fathoms below the surface; at Bradley it is only $20\frac{1}{2}$; and the greater number of beds which cover the main coal at the former place have entirely disappeared before the main seam reaches Bradley; and farther to the north the main seam also crops out and disappears altogether. A very curious phenomenon takes place at Bloomfield colliery, to the south of Bilston, thus described in the 'Geology of England,' p. 412:—"The two upper beds of the main coal, called the roof, floor, and top slipper, separate from the rest, and are distinguished by the name of the 'flying reed.' This separation grows wider, and at Bradley colliery amounts to 12 feet, four beds of shale (slate-clay) and ironstone being interposed. These two upper beds crop out, while the rest of the main coal goes on to Bilston, and is only eight yards thick."

This district supplies coals to the numerous iron-works in the immediate neighbourhood, and the manufactories of Birmingham and its vicinity; besides which, all the neighbouring counties, as far south as Reading and Gloucester, are supplied by means of inland navigation.

The clay ironstone occurs in various beds, but is only wrought in two: one of these is the bed under the main coal, and is wrought for iron-ore.

Many faults or dykes occur in this field; they are usually fissures in the beds, filled up with clay, and very frequently the levels of the different strata vary in consequence. There is a great fault near Bilston, which causes the dip of the strata to be reversed, the beds on the south side dipping south, and those on the north side dipping north: this is however an unusual circumstance.

Western Coal Districts.—The Coal-Fields of this division are dispersed around the transition district of North and South Wales. The north western district includes the coal-fields of Anglesey and Flintshire, the western those of Shropshire, the south-western those of South Wales, of South Gloucester and Somerset, and of the Forest of Dean.

1. Isle of Anglesey.—At the distance of about six miles from the Menai Straits, and running nearly parallel to them, a remarkable valley stretches across the whole island. This valley opens on the north into Red Wharf Bay, and on the south into the æstuary of Maltraeth; it is flanked on both sides by parallel bands of carboniferous limestone, in the depression between which coal has been found, and it is thought probable that the coal-measures may extend through the whole line. Coal has been worked near the Maltraeth æstuary; and a few years since shafts were sunk in the neighbourhood of Trefdaeth. Successful trials have likewise been made at Pentreberen, about five miles north-east of the former pits: the beds are said to be of a tolerable thickness, and the coals of a good quality.

2. Flintshire.—The Coal-Field of this county extends north and south from Llanasa, near the western cape of the æstuary of the Dee, to near Oswestry, in Shropshire, forming an exterior belt coextensive with the range of the mountain line from the north of the Clwyd. Where the carboniferous limestone is partially interrupted by the mountain of Selattyn the coal shales rest immediately on the transition slate, of which that mountain is composed. (Conybeare and Phillips, p. 419.) The greatest length of the district in which the coal-measures are found is about thirty miles, but it must by no means be understood that coal is worked throughout. At Oswestry there is a very small detached piece, not more than three miles long and half a mile broad; there is then an interval of some miles. Near Chirk another coal tract commences, and runs north for about five miles; then another interval occurs; and a little to the north of Wrexham the principal portion begins, and thence extends to the coast, and forms a narrow belt along it to the termination at the west cape of the Dee. The beds dip from one yard in four to two in three, sink beneath the æstuary of the Dee, re-appear on its opposite side, and finally sink beneath the strata of the newer red-sandstone. This position of the coal-measures has led to the conjecture that they are connected with the beds of the Lancashire coal-field. The coal formation here commences with the same strata as those of Derbyshire. The beds of coal vary in thickness from three quarters of a yard to five yards. In the Baggalt mines three seams are worked, varying from 3½ to 7 feet. Common, cannel, and peacock coal are found.

3. The Coalbrook Dale Coal-Field rests on transition rock: it extends from Wombridge, in the parallel of Wellington, to Coal Port, on the Severn, a length of about six miles; its greatest breadth is about two miles. The coal-measures are composed of the usual alternating strata, which occur without much regularity, except that each bed of coal is always immediately covered by indurated or slaty clay, and not by sandstone. The strata are 86 in number. In Madely colliery a shaft is sunk 729 feet through all the beds. The first coal-seam, which occurs at the depth of 102 feet, is very sulphurous, and not more than 4 inches thick; nine other beds of a similar nature, but rather thicker, occur between this and the depth of 396 feet. This coal is called 'stinking coal,' and is only employed in the burning of lime. The first seam of coal that is worked is 496 feet deep and 5 feet thick. Two other beds of coal occur, one 10 inches and the other 3 feet thick, before the bed of 'big flint' sandstone, which is found at the depth of 576 feet: nine beds of coal occur, of the aggregate thickness of 16 feet, between the 'great flint' and the 'little flint' bed (an interval of 100 feet). Beneath the 'little flint' and the lowest bed of the whole formation there is a sulphurous 8 inch coal. This account of the strata refers more particularly to the Madely colliery. The coal of this field is usually a mixture of slate-coal and pitch coal.

West of the Coalbrook Dale Field there are a few detached, narrow, and broken coal-fields in the plain of Shrewsbury, at the other side of the Wrekin.

Several small Coal Fields occur in the Brown Clee Hill and the Titterstone Clee Hill, which rise a few miles south of the Coalbrook Dale Field; the latter hill is about four miles south of the former. The coals in the Brown Clee Hill only lie in thin strata, while the principal stratum in the Titterstone Clee Hill is 6 feet thick. The coal fields on the Titterstone Clee Hill are represented as six detached portions, or separate basins, cut asunder and rendered irregular by a vast basaltic dyke, more than 100 yards wide, which intersects the hill. These coal-measures are more interesting to the geologist than the miner.

On the east of these hills, and between them and the Severn, a Coal-Field extends from Deuxe Hill and Billingsley on the north to the borders of Shropshire and Worcestershire on the south, a length of about eight miles, coal being worked in several points along this line. Coal is also worked near Over Arley, on the Severn, adjoining this tract on the west. Only a few miles from the Billingsley coal-field at Pensax, near the foot of the Abberley Hills, is "a small patch (rather than field) of coal-measures," and another similar piece about three miles to the west.

The South-Western Coal District comprehends the several Coal-Fields near the æstuary of the Severn and the Bristol Channel, including parts of the adjacent counties of Gloucester, Somerset, Monmouth, and Glamorgan. The various coal-fields distributed over this district are apparently insulated, yet they have several points of connection. "They all rest on one common base of old red-sandstone; they all appear to have been formed by similar agency and at the same era; to have been subject at a later period to the same revolutions; and lastly, to have been covered partially by similar overlying deposits." ('Geol. Trans.,' vol. i.) The several basins in the coal formation are divided by lines termed 'anticlinal,' formed by the saddles of the strata or meetings at the surface of their vertical angles, on each side of which the strata dip in opposite directions. The coal-measures are

1. Anticlinal line forming the crest of a hill. 2. The same line running along the course of a valley.

thus surrounded by exterior bands of mountain limestone and old red-sandstone, in the order of the outcrop of the subjacent beds. This district includes three principal coal basins, together with some smaller ones, adjacent to and closely connected with the two last. First, the South Welsh coal basin; second, that of South Gloucester and Somerset; third, that of the Forest of Dean.

1. The Coal-Field of South Wales is upwards of 100 miles in length, and the average breadth in the counties of Monmouth, Glamorgan, Caermarthen, and part of Brecon, is from 18 to 20 miles; it becomes much narrower in Pembrokeshire, being there only from 3 to 5 miles. This area extends from Pontypool on the east to St. Bride's Bay on the west, and forms a vast basin of limestone in which all the strata of coal and ironstone are deposited. The deepest part of the basin is between Neath and Llanelly: from a line ranging nearly east and west through Neath all the strata rise on the south towards the south, and on the north towards the north, cropping out at the edges. The limestone crops out at the surface all round the coal, except where its continuity is interrupted by Swansea and Caermarthen bays. The depths from the surface to the various strata depend upon local situations. The upper coal-seam does not extend a mile either north or south beyond Neath, and not many miles in an east or west direction, and its utmost depth is not above 50 or 60 fathoms; the next stratum of coal and those likewise beneath, being deeper, crop out at a greater distance from the centre; and so of the rest in proportion to their depth. The lowest bed is 700 fathoms deep at the centre, and all the principal strata lie from 500 fathoms deep to this depth. But this district is intersected by deep valleys which generally run in a north and south direction, intersecting the coal. By driving levels in the hills the beds of coal are found without the labour and expense of sinking shafts; there are also many pits in the low valleys. This basin contains twelve beds of coal from 3 to 9 feet thick, making an aggregate of 70½ feet; and there are eleven more from 18 inches to 3 feet, together equal to 24½ feet; the whole thickness is therefore 95 feet. A number of smaller seams likewise occur. On the south side of the basin, from Pontypool to Caermarthen Bay, the coal is principally of a bituminous nature; on the north-east it is a caking coal; on the north-west, anthracitic. It is this latter coal which has the greatest heating power. It is found in abundance near Swansea, and is cheap. Great faults occur in this field, which traverse it generally in a north and south direction, and throw the strata out of their level 40, 60, 80, or 100 fathoms. These dislocations are not often shown on the surface. A principal fault occurs at Cribbath, where the strata of limestone stand erect; another of considerable magnitude lies between Ystradvellte and Penderryn. These dykes are usually filled with clay, but one of some magnitude has been observed near Swansea, which is many fathoms wide and filled with fragments of the disrupted strata, the level of which differs by more than 240 feet. The rich ironstone of this basin supplies extensive iron-works in the neighbourhood. The principal beds of ironstone occur in the lower part of the coal-measures; the most valuable bed is found beneath the lowest coal. The strata of this coal formation dip much more rapidly on the south than on the north; on the south they make an angle of 45° with the horizon, and on the north dipping only 10°. The coal from the South Wales basin supplies the whole of Wales with the exception of the more northern counties, the whole of Cornwall, and the western half of Devonshire.

2. South Gloucester and Somerset Basin.—This basin occupies an irregular triangular space, bounded on the south by the Mendip Hills, which are a high range of mountain limestone resting on an arch of old red-sandstone. The vertex of the triangle is on the north, at the village of Tortworth in Gloucestershire: the western side from the Mendips to the vertex is formed by three insulated masses of high land, separated by narrow intervals, the widest of which is less than

three miles. Near Tortworth the range extending from Almondsbury is deflected suddenly to the south, and this may be considered the north-eastern frontier of the basin; it may also be traced through Wickwar to Sodbury. The south-eastern limit, from Sodbury to near Mells, the eastern extremity of the Mendips, is mostly concealed by overlying deposits. Partial denudations occur at Lansdown, near Wick Rock, where the limestone can be traced in the valleys dipping towards the centre of the coal basin. From Lansdown to the Mendips the continuity of the basin can be well ascertained, the coal-measures being uncovered in some of the valleys in which the principal collieries are situated. In other places shafts have been sunk through the overlying horizontal deposits beneath which the coal is worked. The greatest length of this area is 25 miles; the width, from the collieries near Bath to those of Bedminster near Bristol on the west, is about 11 miles. In this district there is much local irregularity, and the stratification of the coal-measures is so deranged that they have very different and varying levels. In some parts the beds are denuded, in others concealed by the more recent horizontal deposits; and thus the whole basin is divided into several detached coal-fields.

The uncovered areas may be divided into the northern, the central, the southern, the eastern, and the western coal-tracts. The northern is the most extensive and elevated: its greatest length, from the vertex of the basin near Tortworth to the village of Brislington on the left bank of the Avon near Bristol, is 12 miles; its greatest breadth from east to west is nearly four miles. The collieries of Iron Acton, Sodbury, and Kingswood are in this coal-tract. Along the northern limits of the basin, from Sodbury to Cromehall and Titheringtou, the coal-measures are exposed in immediate contact with the limestone; on the western, southern, and great part of the eastern border of the tract they are skirted by hills of red marl capped by lias. At Pucklechurch shafts are sunk to the coal through both the latter formations.

The central tract, which begins on the south of Dundry Hill, is divided into two parts by a narrow valley; the northern portion, about six miles in length, extends from Burnet on the north-east to Knowl Hill, near Stanton Drew, on the south-west; near Pensford it is about two miles in breadth. The southern division, extending from Temple Cloud on the west to between High Littleton and Timsbury on the east, is about three miles in length. To the south-east of this central coal-tract the coal-measures are entirely concealed by superjacent deposits through a distance of six miles. Throughout this space however many shafts are sunk—some through the red marl of the valleys, and some through the lias which occurs on higher ground. There are several of the latter description in the parishes of Timsbury and Poulton; but the deepest is on Clan Down near Radstock, which is sunk 200 fathoms before its horizontal adits are driven. Another shaft, beginning in the oolite, is sunk on the edge of the same Down near Paulton; but it is not so deep as the former, since here there is a rise in the strata, and the coal-seams are in consequence much nearer the surface. On the ascent of the hill above Chilcompton the coal-measures are again exposed to the extent of about an acre.

The southern coal-tract commences near the point where the road between Bath and Shepton Mallet crosses the Nettlebridge stream, and ends between Vobster and Mells; its greatest length is six miles, and greatest breadth two miles and a half. The coal-measures of the eastern coal-tract are laid open in the vale of the Buoyd at Wick and Upton, both in Gloucestershire; they are likewise exposed at Newton St. Leo, on the left bank of the Avon below Bath, dipping towards the interior of the basin. Several seams are worked at Upton and Newton. The western coal-tract lies at the south-east of Leigh Down, near Bristol. Beds of red marl form the upper strata in the shafts of all the coal-pits of this tract between Long Ashton and Bedminster. The coal-field of Nailsea, lying more to the west, is a continuation of this tract.

A great undulation in the strata of the coal-measures which form the coal-basin of Somersetshire and the south of Gloucestershire alters the apparent position of the seams so much that it is very difficult to ascertain the identity of each throughout the various collieries. The local names of the several seams also tend to confuse the geologist.

The chain of hills which limits the western boundary of this coal district presents remarkable anomalies between Clevedon and Portbury along its northern escarpment. A great fault ranging along the edge effects a very considerable subsidence of the strata. In consequence of this "the coal-measures, depressed to the level of the old red-sandstone, appear to occupy its place, and seem to dip beneath the mountain limestone, on which in fact they repose." ('Geol. Trans.,' vol. iv.)

The following are the principal subdivisions of the Coal-Measures in this basin, beginning with the highest:—The Upper Coal Shale; the Pennant Grit (sandstone); the Lower Coal Shale; and the Millstone Grit.

In the Bedminster colliery on the south-west of Bristol there are three seams of good bituminous coal: the deepest and uppermost are worked; the former is 4 feet 3 inches, the latter 2½ feet to 3 feet thick; the middle seam is only 1 foot. The interval between the two principal seams is 23 fathoms; the lowest shaft sunk is 127 fathoms deep. These beds are obviously referrible to the lower coal shale.

In the meridian of Pitcot, situated a little to the north-east of Nettlebridge, all the strata are vertical: a perpendicular shaft is there sunk to the depth of 80 fathoms in one bed of coal.

The total number of mines worked in this district is probably less than it was formerly, but the whole produce is certainly much greater, owing to improved methods in working. The seams of coal are very thin in comparison with those which are worked in the principal coal-fields of England, and in most of those would be rejected as not worth the working.

3. The Forest of Dean Coal-Basin occupies an irregular elliptical area, circumscribed by the triangle formed by the Wye, the Severn, and the road from Gloucester to Ross; the largest diameter from north-north-east to south-south-west is about ten miles, the shorter about six miles. All the strata dip uniformly towards the centre of the basin. The whole of this coal-tract, together with the high land that surrounds it, constitutes a mountain group, the average height of which above the level of the sea is about 900 feet. The aggregate thickness of the whole strata of the coal-measures is, according to Mr. Mushet, 500 fathoms; he divides the different strata into seven series, in which there are 27 beds of coal.

On the north of the Forest of Dean basin, and at the distance of a few miles, is the Newent coal-field, a very small tract surrounded and concealed by overlying strata of the new red-sandstone.

Scotch Coal-Fields.—Several small Coal-Fields occur in Dumfriesshire, forming narrow basins in the valleys of the great southern transition chain of Scotland. In the valley of the Nith, in the parishes of Sanquhar and Kirkconnel, there is one of these coal-basins, about 7 miles in length and 2½ miles in breadth. Three seams of workable coal have been discovered, averaging in thickness from 3 to 4½ feet. The range of the seams is in the direction of the Nith; the measures are disturbed by a dyke running north and south, by which the strata are much depressed on the east side. In the parish of Canobie, adjoining Cumberland, coal is worked in two pits: the principal seam is 5 feet 10 inches thick.

The principal coal-district of Scotland occupies the tract which forms the great central lowland of Scotland, and lies between the great transition chain on the south and the still loftier primitive mountains of the Highlands on the north. "The whole of this wide tract is occupied by the coal-measures, the carboniferous limestone, and the old red-sandstone, associated in every possible manner with vast accumulations of every variety of trap." (Conyb. and Phil.)

To begin with the most eastern county in this tract in which coal is found:—In the parish of Dunbar, on the east coast of Haddington, there are indications of coal, but no seams have yet been found of sufficient thickness for working. In the parish of Ormiston, in the west of the same county, coal is found in abundance; there are three workable seams of coal, varying from 28 to 43 inches in thickness, and the coal is of good quality.

Coal occurs in Fifeshire, on the north side of the Forth. There are mines in the parish of Dysart, where coals were first raised in Scotland nearly 400 years ago. Coal is wrought in several places in Mid-Lothian. In Lanark the coal-fields are numerous and extensive. The Wilsontown coal-basin and the Climpy basin both occur in the parish of Carnwath; the latter is on the west side of the first, the crop of the one nearly approaching the other. There are several seams of coal in these basins. The main coal, or lowest, is called the 4-feet coal; another seam is about 2 feet in thickness. The accompanying strata are sandstone, varying in composition and hardness, bituminous shale, slate-clay, and thin beds of ironstone alternate with the coal. Several small faults, or hitches, as they are here called, traverse the field. On the south-west part of the field the main coal is generally 14 feet below the crow coal, which is the next superior bed; on the north-east the space between the same beds is only about 2 feet. These basins form part of the great coal-basin of the Clyde, which extends on both sides of that river, and the centre of which is near Dalziel. On the same side of the river, in the parish of Monkland, there are many collieries, in which the thickest bed of coal is 9 feet, and it is of good quality. On the left bank of the river coal is wrought in several places. Several mines are worked in the parish of Rutherglen, and others in the adjoining parish of Cambuslang. There are several also in Hamilton, Stonehouse, and Douglass. Throughout this district seven seams of coal are usually found within 415 feet of the surface; five of these seams are of sufficient thickness and good quality to be wrought. The following shows the situation and thickness of the seams of coal in the pits in the parish of Cambuslang:—

	feet.	in.
Upper soil (earth and clay) . . . from 20 to	30	0
Argillaceous white freestone	20	0
Shale, with vegetable impressions, from 30 feet to 40 feet	35	0
1st Seam, soft coal	4	6
Interval (hard freestone, &c.)	26	6
2nd Seam, soft coal	3	6
Interval (shale)	63	6
3rd Seam, shaft coal	5	0
Interval { shale, 20 feet; hard ironstone, from 6 to 18 inches; shale and freestone } .	65	2
4th Seam, soft coal	6	0
Interval { shale; freestone }	83	0

	feet.	in.
5th Seam, soft coal	3	0
Interval { ironstone / shale }	10	0
6th Seam, hard coal, good for iron works, forges, &c.	3	6
Interval (shale)	1	6
7th Seam, soft coal	1	6
Till, &c., with thin seams of coal	84	0
	445	8

The thickness of the coal and of the freestone varies considerably in different parts, and the numbers here given must be taken only as an approximation. The strata are frequently deranged by faults, several of which run from east to west. In their general arrangement the strata usually run nearly parallel to each other, although they have always a considerable angle of elevation, and uniformly dip towards the Clyde. A great fault occurs between Hamilton and Quarter, and none of the principal seams are wrought for some miles north of this spot, the coal beds being sunk nearly 100 fathoms lower than those out of the fault. The main seam worked at Quarter is 5 feet 6 inches thick, and consists of four distinct varieties of coal.

This Coal-Basin of the Clyde extends into Renfrew, where there are many collieries. Coal is wrought in the parish of Eastwood, in that county, in several seams of various thickness, but none exceed 2 feet 6 inches. The whole are of good quality. Five of them are wrought in pits varying in depth from 10 to 40 fathoms. The coal-measures here consist of the usual series of freestone, shale, &c., dipping generally to the south-west. This coal formation partly surrounds the Loch of Castle Semple, and continues without interruption into Ayrshire, around Kilbirnie Loch, and onwards to Ardrossan. Coal occurs in different places in Dumbarton, where, among other parishes, it is wrought in Easter Kilpatrick. It is also found abundantly in Stirlingshire, along the southern base of the Lennox Hills. Coal likewise occurs throughout Linlithgow, and is worked extensively in that county; it is likewise found in Clackmannan and in the south of the counties of Perth and Kinross.

Some of the richest and most valuable bands of ironstone are obtained from the coal-measures of Scotland, chiefly in the basin of the Clyde. The manufacture of iron in this district is very extensive. In the year 1849 nearly 700,000 tons of pig-iron were wrought in this district. The Scotch beds include a large proportion of sandstone and a peculiar limestone, worked at Burdie House near Edinburgh. The remains of plants and animals are found in these rocks, and amongst the latter the *Megalichthys*, a fossil fish of large size and interesting structure. [MEGALICHTHYS.]

Irish Coal-Fields.—Mr. Griffiths, in his 'Report on the Leinster Coal District,' gives an excellent summary of the Irish coal-fields, from which what follows is taken:—"If we except the Leinster district my knowledge of the coal-fields of Ireland is as yet very limited; and though each in its turn will form the subject of a separate report, I think it right to draw attention to them in this place, by giving such general information as I possess respecting their situation and circumstances. Coal has been discovered in more or less quantity in seventeen counties of Ireland; but I believe the island contains but four principal coal-districts namely, the Leinster, the Munster, the Connaught, and the Ulster. The two former contain carbonaceous or stone-coal, and the latter bituminous or blazing coal.

"The Leinster coal-district is situated in the counties of Kilkenny, Queen's County, and county of Carlow. It also extends a short distance into the county of Tipperary, as far as Killenaule. This is the principal carbonaceous coal-district. It is divided into three detached parts, separated from each other by a secondary limestone country, which not only envelops, but in continuation passes under the whole of the coal-district; a fact which was indisputably, though accidentally, proved by the Grand Canal Company, who sank a pit through 18 yards of black slate-clay and flinty slate into the limestone in search of coal. The Leinster coal-district is therefore of subsequent formation to the limestone.

"The Munster coal-district occupies a considerable portion of the counties of Limerick and Kerry, and a large part of the county of Cork. It is by much the most extensive in Ireland; but as yet there is not sufficient information respecting the number, extent, or thickness of the beds of coal it may contain.

"Coal and culm have been raised for near a century in the neighbourhood of Kanturk, in the county of Cork. At Dromagh colliery I understand the work has been carried on to a very considerable extent, and its annual supplies of coal and culm have materially contributed to the agricultural improvement of an immense extent of the great maritime and commercial counties of Cork and Limerick, which must otherwise have continued neglected and unreclaimed.

"Many circumstances combine to make the examination of this district of peculiar interest and importance; and as a recent application has been made by the Cork Institution to the Dublin Society to aid the undertaking, it is probable that this immense district will shortly be accurately explored. From all that has been ascertained, it is very clear that the dip of the beds and the quality of the coal differ materially from those of the Leinster district. In the Munster district the beds run east and west, and dip to the south, forming an angle of 45°. In the Dromagh colliery, where all the beds which have been discovered have been successively and in general successfully wrought, four beds incline on each other, and at no greater distance than 200 yards. The first of these beds is a 3-feet stone-coal, and is the leading bed. All faults, checks, and dislocations, similar to those which are discoverable in this bed, are in general to be encountered in the other three. The names of the four beds are, the *coal-bed*—this lies farthest to the north; the *rock-coal*, so called from its being comparatively of harder quality than the other beds; the *bulk-bed*, so called from its contents being found in large masses or bulks; and *Bath's-bed*, so called from the name of a celebrated English miner, by whom it had been many years ago discovered and worked. The coal-bed consists of 3-feet solid coal, and is not sulphurous; the rock-coal is nearly of the same thickness with the leading bed, but is very sulphurous, and, having the soundest roof, is the most easily wrought. The other beds are of the culm species, but of peculiar strength. . . . The bulk-bed forms immense bulks and masses of culm, in which the miners have frequently been unable to retain the ordinary directions of roof and seat.

"No work has been undertaken in the Munster coal-district to a greater depth than 80 yards. The present work at the Dromagh colliery is at that depth; it is heavily watered, and consequently expensively wrought. The quality of the coal and culm improves as the work descends. . . .

"The Connaught coal-district stands next in order of value and importance to the Leinster and Munster, and possibly may be found to deserve the first place when its subterranean treasures shall be explored. At present nothing is known, except that the outer edges of several beds of coal have been observed, but they have not been traced to any distance, so that their extent is by no means ascertained. The coal is of the bituminous species. This coal is particularly adapted to the purposes of iron-works, foundries, &c. &c.

"The Ulster coal-district is of trifling importance when compared with the foregoing. It commences near Dungannon, in the county of Tyrone, and extends in a northern direction to Coal Island, and in continuation to the neighbourhood of Cookstown. No beds of coal worth working have hitherto been discovered between Coal Island and Cookstown, but certainly the coal strata extend there. The principal collieries are at Coal Island and at Dungannon. The coal of this district is bituminous. I understand that indications of coal have been observed at Drumquin, in the county of Tyrone; and also at Petigoe, to the north of Lough Erne. Possibly the coal formation may extend from the neighbourhood of Cookstown westward to the north of Lough Erne.

"Besides the foregoing principal coal-districts, there are others of less consequence. Bituminous coal has been found in the neighbourhood of Belturbet, in the county of Cavan, and at the collieries of Ballycastle, in the county of Antrim; but the Antrim coal-district is not very extensive. These collieries have been wrought for a number of years. The coals are of a slaty nature, and greatly resemble both the coal and the accompanying rocks which occur in Ayrshire, and probably they belong to the same formation."

Continental Europe.—France.—In the centre and south of France some small coal-fields occur in the valleys of the Loire, the Allier, the Creuse, and the Dordogue, the Aveyron, and Ardèche, between ridges proceeding from the primitive central group connected with the Cevennes; and, in a few localities, some of the thickest beds of coal yet discovered have been found. In the north of France, the coal-formation occupies a very large tract of country, running westward from Hardinghen, near Boulogne, by Valenciennes, and thence up the Schelde and down the Meuse to Eschweiler, beyond Aix-la-Chapelle. The total area of coal in France is probably not less than 2000 square miles. Its annual yield is not less than 4,000,000 tons. These deposits are of the same age as those of England, but they rest on granite or other crystalline and metamorphine rocks.

Belgium.—The district along the Meuse, between Namur and Liège, is said to resemble in its geological structure, as well as picturesque features, the Somersetshire and South Gloucester district: the strata being broken and deranged, exhibit, if possible, still more contorted and inverted positions of the respective beds. The defiles of the Sambre and the Meuse ('Geol. Trans.,' vol. i., 2nd series) present an exact counterpart of those of the Avon and the Wye. There are two principal coal-fields in Belgium, the one extending to the east and known as the Liège Coal-Field, and the other west forming the Hainault division. The seams are generally thin, remarkably numerous, and presenting an apparent multiplication by doublings of the strata. A kind of coal is found in Belgium called Fleuu Coal, which is not found in Great Britain. It burns rapidly, giving out a disagreeable smell. [BELGIUM, in GEOG. DIV.]

Germany.—The coal-districts in the north of Germany are probably the prolongation of the Belgium formation. On the north-east and south-east of the Harz Mountains, near Ballenstadt and Neustadt, the coal-formation occurs resting on the transition rock of that group. In Saxony coal is found in many places along the northern foot of the Erzegebirge. It is extensively worked near Zwickau and near Dresden. There is a very extensive coal-district in Bohemia, extending into Upper Silesia. This district lies between the great primitive chain of the Erzegebirge and the Riesengebirge, on the north, and the great district of primitive slate which occupies the larger part of Bohemia south of the Beraun and Upper Elbe. More than forty beds of coal are supposed to be worked in this district. The whole annual supply from Prussia and the German States of the Zollverein exceeds 2,750,000 tons.

Russia.—Good coal has been found in Southern Russia, near Toula, lat. 54°, long. 37°, where it is worked; but the quantity is so small, and the difficulty of working it beneath a loose and half-liquid bed of quicksand is so great, that it seems unlikely to be of much utility. Coal has also been worked at Bakhmout, lat. 48°, loug. 38°, in the government of Katerinoslaf. (Mr. Strangways on the Geology of Russia, 'Geol. Trans.,' vol. i., 2nd series, p. 35.)

Sweden.—Coal occurs in this country near Helsingborg at the entrance of the Baltic, and also in the island of Bornholm. [BORNHOLM, in GEOG. DIV.]

Spain.—Both bituminous coal and anthracite are found in Spain. The richest beds are in Asturias, where the measures are so much broken and altered as to be worked by almost vertical shafts driven through the beds. The area covered by coal-beds in Spain is not exactly known, but it is said to be the largest in Europe, presenting upwards of 100 workable seams varying from 3 to 12 feet in thickness. (Austed.)

Hungary and some other countries in the east of Europe contain coal-measures which appear to belong to the carbouiferous period. It has been conjectured that coal exists in several parts of continental Greece. Coal is said to be found north of Constantinople.

Asia.—In Asia coal has long been known in China, where it is said to have been worked as early as the 13th century. Mr. Williams says that both bituminous coal and anthracite are seen in the coal marts of the north of China. Coal is likewise found in the countries immediately around the Persian Gulf, but of a very indifferent description. In most parts of Cutch, coal occurs in abundance and of good quality; it ignites quickly, and burns to a white ash. Coals are also found in Bundelcund. There are large mines in the district of Burdwan, 130 miles from Calcutta, and worked to the extent of 14,000 or 15,000 tons annually. They are situated on the banks of a river connected with the Hoogly, and were first worked about thirty-five years ago, but they have not been in extensive operation more than twenty-five years; the principal seam is about 9 feet thick, and is about 90 feet from the surface. Coal has likewise been got from a mine opened near Bhaugulpoor, on the Ganges, about 300 miles from Burdwan. Another coal-field has been discovered on the banks of the Hoogly, near Merzipoor, about forty miles from Calcutta; the coal is found close to the surface, and the thickness of the principal seam is said to be 2 feet. Coal of good quality likewise occurs in the Birman Empire.

America.—Professor Ansted says, "It is only within a few years that the coal-measures of the continents of America have been in any way known, and we are even now in ignorance of many details with regard to the greater number; but enough is ascertained to convince any unprejudiced person that the supply of mineral fuel there obtainable is amply sufficient for the requirements of the whole civilised world for thousands of years, even should the demand increase rapidly and the consumption continue to bear reference to the multiplication of all kinds of industrial occupation. There are in North America four principal coal areas, compared with which the richest deposits of other countries are comparatively insignificant. These are the great central Coal-Fields of the Alleghanies; the Coal-Field of Illinois and the basin of the Ohio; that of the basin of the Missouri; and those of Nova Scotia, New Brunswick, and Cape Breton. Besides these there are many smaller coal areas which in other countries might well take rank as of vast national importance, and which even in North America will one day contribute greatly to the riches of various states. We will endeavour to give a brief outline of the main facts concerning the chief of these districts.

"The Alleghany or Appalachian Coal-Field measures 750 miles in length, with a mean breadth of 85 miles, and traverses eight of the principal states in the American Union. Its whole area is estimated at not less than 65,000 square miles, or upwards of 40,000,000 of acres. The area is thus distributed—

Name of States.	Area in Acres.
Alabama	2,250,000
Georgia	100,000
Tennessee	2,750,000
Kentucky	5,750,000
Virginia	13,500,000
Maryland	350,000
Ohio	7,500,000
Pennsylvania	9,500,000
	41,700,000

"Making a liberal deduction for unproductive portions, denuded and eroded strata, and the parts of the seams out of reach, we may still fairly calculate that there exists in this district an area of 25,000,000 acres of productive coal-measures. The working has already commenced in most of the states above mentioned, though not generally to any very considerable extent. Thus in Alabama, the beds alternate with the usual sandstones, shales, and clays, and the coal-seams worked seem to be from 4 to 10 feet thick, and are quarried at the surface. They repose on grits and appear on the two sides of an anticlinal. The coal is bituminous and used for gas. In Kentucky both bituminous and cannel coal are worked in seams about 3 or 4 feet thick, the cannel being sometimes associated with the bituminous coal as a portion of the same seam; and there are in addition valuable bands of iron-ore. In Western Virginia there are several coal-seams of variable thickness, one 9½ feet, two others of 5 feet, and others 3 or 4 feet. On the whole there seems to be at least 40 feet of coal distributed in thirteen seams. In the Ohio district the whole coal-field affords on an average at least 6 feet of coal. The Maryland district is less extensive, but is remarkable as containing the best and most useful coal, which is worked now to some extent at Frostburg. There appears to be about 30 feet of good coal in four seams, besides many others of less importance. The quality is intermediate between bituminous and anthracitic, and it is considered well adapted to iron-making. Lastly, in Pennsylvania there are generally from two to five workable beds, yielding on an average about 10 feet of workable coal, and amongst them is one bed traceable for no less than 450 miles, consisting of bituminous coal, its thickness being from 12 to 14 feet on the south-eastern border, but gradually diminishing to 5 or 6 feet. Besides the bituminous coal there are in Pennsylvania the largest anthracitic deposits in the States, occupying as much as 250,000 acres and divided into three principal districts. The Illinois Coal-Field, in the plain of the Mississippi, is only second in importance to the vast areas already described. There are four principal divisions traceable, of which the first or Indiana district contains several seams of bituminous coal, distributed over an area of nearly 8000 square miles. It is of excellent quality for many purposes; one kind burning with much light and very freely, approaching cannel coal in some of its properties; other kinds consist of caking or splint coal. In addition to the Indiana Coal-Field, there appears to be as much as 48,000 square miles of coal area in the other divisions of the Illinois district. Although these are less known and not at present much worked, 30,000 square miles are in the State of Illinois, which supplies coal of excellent quality and with great facility. The coal is generally bituminous. The third great coal area of the United States is that of the Missouri, which is little known at present, although certainly of great importance. From the account given of these localities the reader will be able to appreciate in some measure the mineral resources of the United States, and may perceive also the importance of geological knowledge in recognising the laws of the position of a material so valuable.

"British America contains very large supplies of coal in the provinces of New Brunswick and Nova Scotia. The former presents three coal-fields, occupying in all no less than 57,000 square miles; but the latter is far larger, and exhibits several very distinct localities where coal abounds. The New Brunswick coal-measures include not only shales and sandstones, as is usual with such deposits, but bands of lignite impregnated with vitreous copper-ore and coated by green carbonate of copper. The coal is generally in thin seams lying horizontally. It is chiefly or entirely bituminous."

Nova Scotia contains a great quantity of coal. The great coal-field of Pictou has been traced from Carriboo Harbour to Merigomish, comprising an area of more than 100 square miles. The seams of coal resemble much more those of Staffordshire than those in the north of England. One bed is described by a practical miner, who went to Nova Scotia to superintend the opening of the mines, as 40 feet in thickness; it is not however equally good throughout, and it was thought advisable to work only 10 feet of the upper part. According to Bouchette, the seams of this field vary in thickness from 1 foot to 50 feet. The coal is highly bituminous and burns well. There is another coal-field, also of considerable extent, in the north-west part of the county of Northumberland, between the river Macan and the shores of the Chignecti Channel. In this district there are eight strata of coal, varying from 1 foot to 4 feet in thickness. This coal is not considered so good as that of Pictou. There are also indications of coal in the township of Londonderry and at Onslow; on the north shore of the Mina's basin; at the head of Pomket Harbour, in the upper district of the county of Sydney; and on the south shore of Wallace Harbour, in the county of Cumberland. (Bouchette.)

Coals of excellent quality are got in Cape Breton. The coal-measures have been traced in the western part of the island, on Inhabitants River, at Port Hood, and at Mabou. On the east the Sydney Coal-Field is of great extent; it commences at Miray Bay and runs along the coast to the Great Bras d'Or, being in length about 40 miles, and averaging 5 miles in breadth. "From a minute calculation, after deducting harbours, bays, and all other interpositions, it appears that there are 120 square miles of land, containing available veins of coal." (Bouchette.) The measures in this district contain fourteen beds of coal, varying from 3 to 11 feet in thickness. The coal is wrought at Sydney Harbour and at Lingan.

Coal is found very abundantly in Australia, and is worked extensively in the Newcastle district, on the Hunter's River. A coal formation likewise occurs in Van Diemen's Land; and coal has been found and is wrought in several parts of New Zealand.

Fossils of the Coal Formation.

The plants found in this deposit are so important that a separate article, COAL PLANTS, is devoted to them. The animal remains found have only been occasionally alluded to; we accordingly furnish a list of the genera of animals found in the entire Carboniferous System of Great Britain, as given in Professor Tennant's list of British Fossils. Where the species are more than one, the number is given, but where there is but one the specific name is added.

AMORPHOZOA.	
Tragos, semicirculare	

ZOOPHYTA.	
Amplexus	2
Alecto arenosa	
Astræopora antiqua	
Aulopora	2
Berenicea (?) megastoma	
Caryophyllia	3
Chætetes radians	
Cladocora	2
Cyathophyllum	2
Favosites capillaris	
Fenestella	20
Flustra palmata	
Glauconome	4
Gorgonia	2
Hemitrypa Hibernica	
Ichthyorachis Newenhami	
Jania	3
Lithodendron	3
Lithostrotion	4
Michelinia tenuisepta	
Orbiculites antiquus	
Polypora	4
Ptilopora pluma	
Pustulopora	2
Retepora undata	
Stromatopora subtilis	
Syringopora	2
Turbinolia expansa	
Vincularia	4

ECHINODERMATA.	
Actinocrinus	10
Atocrinus Milleri	
Cyathocrinus	9
Echinocrinus	5
Euryocrinus concavus	
Gilbertsocrinus	4
Palæchinus	5
Pentatrematites	8
Phillipsocrinus caryocrinoides	
Platycrinus	16
Poteriocrinus	8
Rhodocrinus	2
Synbathocrinus conicus	
Taxocrinus	4

ANNELIDA.	
Sabella antiqua	
Serpula	5
Serpulites	2
Spirorbis	4
Spiroglyphus marginatus	

INSECTA.	
Curculioides	2

CRUSTACEA.	
Apus dubius	
Asaphus quadrilimbus	
Bairdia	2
Cyclus radialis	
Cypris (?)	4
Cythere	17
Cytherina Phillipsiana	
Daphnia primæva	
Dithyrocaris	3
Entomoconchus Scouleri	
Eurypterus Scouleri	
Griffithides	5
Limulus	3
Phillipsia	11

CONCHIFERA DIMYARIA	
Amphidesma (?)	4
Anatina	2
Arca	2
Artemis parva	
Astarte	2
Axinus	7
Byssoarca	5
Cardinia (?)	5
Cardiomorpha	3
Cardium orbiculare	
Corbis cancellata	
Corbula senilis	
Crenella acutirostris	
Cucullæa	3
Cypricardia	11
Cyprina	2
Dolabra	5
Donax primigenius	
Edmondia uniformis	
Isocardia axiniformis	
Kellia gregaria	
Lanistes	2
Leptodomus	2
Lithodomus dactyloides	
Lucina	2
Lutraria	3
Mactra ovata	
Modiola	9
Mytilus	3
Nucula	22
Pandora clavata	
Pinna	4
Pleurorhyncus	10
Psammobia decussata	
Pullastra	4
Sanguinolites	19
Sedgwickia	6
Solemya primæva	
Solen pelagicus	
Venerupis	3
Venus	4
Ungulina antiqua	
Unio (?)	3

CONCHIFERA MONOMYARIA.	
Anomia antiqua	
Avicula	16
Gervillia	4
Inoceramus	7
Lima	8
Meleagrina	6
Monotis æqualis	
Pecten	75
Posidonomya	9
Pterinea	3
Pteronites	5

BRACHIOPODA.	
Atrypa	9
Chonetes	12
Crania vesiculosa	
Leptæna	4
Lingula	5
Orbicula	4
Orthis	17
Productus	46
Spirifer	59
Terebratula	26

GASTEROPODA.	
Acroculia	4
Buccinum	8
Cirrus	5
Dentalium inornatum	
Elenchus	2
Euomphalus	17
Fissurella elongata	
Globulus	3
Lacuna antiqua	
Loxonema	11
Littorina pusilla	
Macrocheilus	5
Metoptoma	5
Microconchus carbonarius	
Murchisonia	8
Natica	8
Naticopsis	5
Nerita	2
Patella	5
Phanerotinus	2
Platyceras	3
Platyschisma	3
Pleurotomaria	41
Pyramis	2
Siphonaria Koninckii	
Terebra constricta	
Trochella prisca	
Turbo	5
Turritella	8
Umbrella lævigata	

PTEROPODA.	
Conularia quadrisulcata	

HETEROPODA.	
Bellerophon	19
Porcellia	3

CEPHALOPODA.	
Actinoceras	2
Cyrtoceras tuberculatum	
Goniatites	54
Nautilus	42
Orthoceras	32
Phragmoceras flexistria	

PISCES.

Placoides.	
Onchus	6
Ctenacanthus	6
Ptychacanthus sublævis	
Sphenacanthus serrulatus	
Asteroptychius	2
Physonemus subteres	
Gyracanthus	4
Oracanthus	4
Leptacanthus	2
Tristychius arcuatus	
Cladacanthus paradoxus	
Cricacanthus Jonesii	
Orodus cinctus	
Orthacanthus cylindricus	
Pleuracanthus	4
Helodus	9
Chomatodus	3
Cochliodus	5
Psammodus	4
Pœcilodus	6
Pleurodus	2
Ctenoptychius	8
Ctenodus	4
Petalodus	8
Cladodus	7
Diplodus	2

Ganoides.	
Acanthodes sulcatus	
Amblypterus	3
Palæoniscus	6
Eurynotus	2

Sauroides.	
Megalichthys	2
Diplopterus	2
Pygopterus	3
Acrolepis acutirostris	
Orognathus conidens	
Graptolepis ornatus	
Pelodus capitatus	
Cœlacanthus	2
Holoptychius	8
Holopygus Bennei	
Ecronemus lobatus	
Phylolepis tenuissimus	

COAL PLANTS. That coal is the result of the mineralisation of vegetable remains is abundantly proved, both by the numerous impressions of plants found in connection with it, and by the traces of organisation which are still discoverable in it.

In general the impressions of plants occur chiefly in the shale of the coal-measures, that is, in the mud which separates the seams of coal, or in the sandstone or ironstone associated with the coal formation; and as such impressions are much more distinct than any that occur in the coal itself, it is chiefly from them that our ideas of the vegetation from which coal has been produced have been derived. They are often present in inconceivable beauty and abundance, as may be imagined from Dr. Buckland's graphic account of those in the coal-mines of Bohemia. In his 'Bridgewater Treatise,' he says:—"The finest example I have ever witnessed is that of the coal-mines of Bohemia just mentioned. The most elaborate imitations of living foliage upon the painted ceilings of Italian palaces bear no comparison with the beauteous profusion of extinct vegetable forms with which the galleries of these instructive coal mines are overhung. The roof is covered as with a canopy of gorgeous tapestry, enriched with festoons of most graceful foliage, flung in wild irregular profusion over every portion of its surface. The effect is heightened by the contrast of the coal-black colour of these vegetables with the light ground-work of the rock to which they are attached. The spectator feels himself transported, as if by enchantment, into the forests of another world; he beholds trees of forms and characters now unknown upon the surface of the earth, presented to his senses almost in the beauty and vigour of their primeval life; their scaly stems and bending branches, with their delicate apparatus of foliage, are all spread forth before him, little impaired by the lapse of countless ages, and bearing faithful records of extinct systems of vegetation, which began and terminated in times of which these relics are the infallible historians."

Such remains consist chiefly of impressions of leaves separated from their branches, and of casts of trunks more or less in a broken state; and with them occur now and then pieces of wood or remains of trees in which the vegetable texture is to some extent preserved. Of the leaves the greater part is more or less mutilated; those of ferns, which are extremely numerous, have lost their fructification in the majority of instances; and it frequently happens that the leaflets of compound leaves have been disarticulated either wholly or partially. Stems or trunks are in all cases in a state which must be supposed to result from decay previously to their conversion into coal; destitute of bark, or with the principal part of that envelope gone, and often pressed quite flat, so that all trace of their original convexity is destroyed. Where ripe fruits are met with, they are not in clusters as they probably were when alive, but separated into single individuals. Of flowers there is no trace that can be satisfactorily identified; for *Antholithes Pitcairniæ*, the most perfect that has yet been discovered, is altogether of a doubtful nature.

It will at once be seen that the investigation of plants in such a condition is very much more difficult than that which is presented by a recent Flora. The nature of the inquiries, and the difficulties presented to an investigator of the plants of the coal formation, have been well described by Dr. Joseph D. Hooker, in a paper 'On the Vegetation of the Carboniferous Period as compared with that of the Present Day,' in the second volume of the 'Memoirs of the Geological Survey of Great Britain.' His remarks are arranged under four heads—the nature of the plants, their geographical distribution, relation to the soil, and the reciprocal influence of the whole mass of the vegetation on the surface it covers:—

"1. Of the mutual affinities of the groups under which the majority of the genera of coal-plants arrange themselves little more can be said but that the ferns occupy the lower end of the series and the *Coniferæ* possibly the highest; but this depends upon the view taken of the affinities of *Sigillariæ*, the most important group. These are classed by some observers amongst Ferns, by others with *Coniferæ*, another considers them as linking these two widely-different families, whilst a fourth ranks them much higher than either. The affinities of another group, *Calamites*, are entirely unascertained. Of the whole amount of species in each no conjecture can be formed, or any but a very rough one, of the number into which those with which we are familiar as of common occurrence should be divided. The Ferns far outnumber probably all the others; but this again materially depends on the value according to the markings of *Sigillariæ*, as means of dividing that genus; for if the slight differences hitherto employed be insisted upon, the number of the so-called species may be unlimitedly increased.

"2. With regard to the geographical distribution of the species, &c., it appears that a uniformity once existed in the vegetation throughout the extra-tropical countries of the Northern Hemisphere, to which there is now no parallel; and this was so whether we consider the coal-plants as representing all the flora of the period, or a part only, consisting of some widely-distributed forms that characterised certain local conditions. Nor is this uniformity less conspicuous in what may be called the vertical distribution; the fossils in the lowest coal-beds of one field very frequently pervading all the succeeding beds, though so many as thirty may be interposed between the highest and the lowest.

"3. Of the relations between the soil and the plants nourished by it, little more is recognisable than that the *Sigillariæ* have been particularly abundant on the under clay, which, judging from the absence of any other fossils but *Sigillariæ* roots (*Stigmaria*), seems to have been either in itself unfriendly to vegetation, or so placed (perhaps from being submerged) as to be incapable of supporting any other. The latter is the most probable, because both *Sigillariæ* and their *Stigmaria* roots occur in other soils, besides under clay, and are there accompanied by *Calamites*, Ferns, &c. The *Coniferæ* again are chiefly found in the sandstones, and their remains being exceedingly rare in the clays, shales, or ironstones, it may be concluded that they never were associated with the *Sigillariæ* and other plants which abound in the coal-seams, but that they flourished in the neighbourhood, and were at times transported to these localities. The quantity of moisture to which these plants were subjected must remain a question so long as some authors insist upon the *Sigillariæ* being allied to plants now characteristic of deserts, and others to such as are the inhabitants of moist and insular climates. The singular succulent texture and extraordinary size of both the vascular and cellular tissues of many, possibly indicate a great amount of humidity. The question of light and heat involves a yet more important question, some of the coal-plants of the arctic regions being considered identical with those of Britain. How these can have existed in that latitude under the now prevailing distribution of light and heat has not been hitherto explained; they are too bulky for comparison with any vegetables inhabiting those regions at the present time, and of too lax a tissue to admit of a prolonged withdrawal of the stimulus of light, or of their being subjected to continued frosts.

"4. The consequence of the existence of the coal-plants has been the formation of coal; but how this operation was conducted is a question yet unsolved. The under-clay or soil upon which the coal rests, and upon which some of the plants grew, seems in general to have suffered little change thereby, further than what was effected by the intrusion of a vast number of roots throughout the mass. The shales on the other hand are composed of inorganic matter, materially altered by the presence of the vegetable matter they contain. The iron-clays again present a third modification of this mixture of organic and inorganic matter, often occurring in the form of nodules. These nodules seem to be the result of a peculiar action of vegetable matter upon water, charged with soil and a salt of iron; the ironstone nodules of existing peat-bogs appearing altogether analogous to those of the carboniferous period, whether in form or in chemical constituents. Here then the botanist recognises in one coal-seam a vegetable detritus under three distinct phases, and which has been acted upon in each by very different causes. In the under-clay there are roots only; these permeate its mass as those of the water-lily and other aquatic plants do the silt at the bottom of still waters.

"The coal is the detritus either of those plants whose roots are preserved in the under-clay, or of those together with others which may have grown amongst them or at a distance, and have been afterwards drifted to the same position. Above the coal is the third soil, bearing evidence of the action of a vigorous vegetation; this is the shale, which has all the appearance of a quiet deposit from water charged with mineral matters, and into which broken pieces of plants have fallen. Here there is so clear a divisional line between the coal and shale that it is still a disputed point whether the plants contained in the latter actually grew upon the former, or were drifted to that position in the fluid which deposited the mineral matter. Amongst the shales are also interspersed in many cases innumerable stumps of *Sigillariæ*, similar to those whose roots occur in the under-clay, and which are themselves found attached to those roots in soils similar to the under-clays, but unconnected with any seam of coal. These stumps are almost universally erect, are uniformly scattered over the seams, and otherwise appear to have decidedly grown on the surface of the coal; the shales likewise seem deposited between these stumps. The rarity of *Sigillariæ* roots (*Stigmaria*) in this position is probably due to their being incorporated with the coal itself, though they sometimes occur above that mineral and between the layers of shale. The seams of ironstone (or black band) are the last modifications of soil by vegetable matter to which allusion has been made. When these are uniform beds or layers, they may be supposed to be the deposit from water charged with iron and soil which has percolated through the peat, and in so doing absorbed a great deal of vegetable matter. The layers of nodular ironstone are simple modifications of these, and may be caused by the sedimentary particles contained in the fluid, which instead of being deposited in a uniform stratum, are aggregated round bits of vegetable matter (as fern leaves, stems, or cones) which served as nuclei.

"Now, though each of these points admits of some explanation when taken separately, and some illustration from the action of an existing vegetation on the soil, &c., it is very difficult to understand their combined operation over so enormous a surface—for instance, as one of the American coal-fields—and even more to account for their regular recurrence according to some fixed law in every successive coal-seam throughout the whole carboniferous formation."

Coal-plants may be divided for practical purposes into three classes: 1, those of which only wood still containing organic structure has been found; 2, those which have an obvious analogy with recent plants; 3, those with which no existing analogy has been traced.

1. *Coal-Plants of which Wood only containing Organic Structure has been found.*

The existence of wood in the coal formation with its texture still preserved, is a discovery of very modern date. Mr. Nicol, of Edinburgh, claims the credit of having first invented the art of preparing fossil wood so as to show its structure microscopically; Mr. Witham has investigated the subject extensively, and he has been followed by Messrs. Lindley, Hutton, and others. The result of these inquiries has been, that wood still preserving its texture exists in a mineral state extensively throughout the coal-mines of the north of England; that it in most cases has a structure analogous to, although not identical with, that of recent coniferous wood; and that in those cases in which its structure is not coniferous it is unlike that of any existing trees.

Coniferous wood is known amongst other things by the presence of small discs upon the sides of its woody tubes; differences in the arrangements of these discs have given rise to the formation of the genera *Peuce* and *Pinites*, to one or other of which all the coniferous coal-wood seems referrible. Mr. Nicol believes that it may all be referred to either the existing genera *Pinus* or *Araucaria*. Specimens of this kind of wood occur sometimes of considerable size. A trunk of *Pinites Brandlingi* has been found 72 feet long, and another of *Pinites Withami* 36 feet long.

The wood to which Mr. Witham's genus *Anabathra* apparently belongs is known by its longitudinal section representing tubes marked by parallel transverse lines resembling the steps of a ladder. This is very uncommon, and is stated by Messrs. Lindley and Hutton to belong to the genus *Stigmaria*, mentioned hereafter.

Specimens in ironstone also have occurred of the wood of the genus *Lepidodendron*. It consists principally of loose cellular tissue, having near the centre a zone of spiral vessels, connected with the bases of the leaves by arcs of spiral vessels, and having rudiments of wood on the outside of the zone.

2. *Coal-Plants which have an obvious Analogy with Recent Plants.*

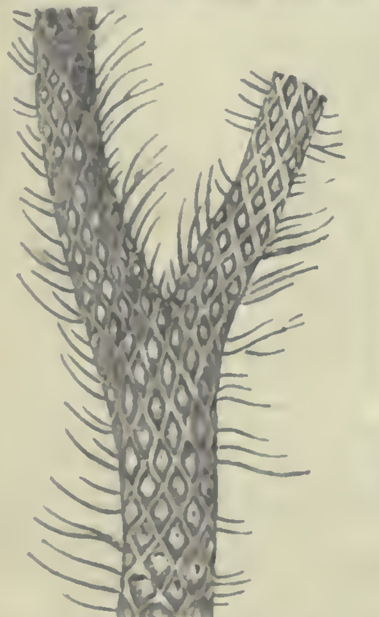
Coniferous plants have but few remains, except wood, by which they can be recognised. A cone of *Pinus anthracina* has been met with, and there is reason to believe that certain stems called *Bothrodendron*, having numerous minute dots upon their surface, and deep circular oblique concavities 4 or 5 inches across, at intervals of 10 or 11 inches, are also remains of trees of this description. It is probable moreover that some of the fossils referred to the genus

Lepidodendron are really coniferous plants, especially *L. longifolium;* but upon this point nothing certain is known.

It was at one time supposed that the remains of palms had been found: the evidence, however, upon which this supposition rests is considered by M. Brongniart and Dr Hooker as insufficient. The only portions of plants supposed to be palms that have been found, are the remains of fruits. These remains are generally oblong 3-sided or 6-sided bodies, not more than an inch long. They have been named *Trigonocarpum Noggerathi.*

Trigonocarpum Noggerathi.

Lycopodiaceous plants, or what are considered analogous to them, form a very large proportion of the vegetable remains of the north of England coal-field. They are represented by impressions closely covered either with lozenge-shaped spaces disposed in a spiral manner, or by small scale-like leaves, which are supposed to have produced those spaces by falling off. When they branch they have often been observed to do so in a forked or dichotomous manner. Sometimes they are minute, and no larger than existing *Lycopodia*, but they are occasionally found of considerable size, some having been seen which, although mere fragments, were between 40 and 50 feet long, and more than 4 feet in diameter. An idea of their appearance will be gained from the accompanying figure of *Lepidodendron Sternbergii.*



Lepidodendron Sternbergii.

Lepidostrobus variabilis.

Associated with them are narrow sharp-pointed leaves resembling scales, which no doubt belonged to them, but which are distinguished by the name of *Lepidophyllum.* In the same formations are found cones of different sizes, consisting of small sharp-pointed lax scales, in the axils of which were seeds: these have been supposed to be the fructification of *Lepidodendron*; but as there is no actual certainty of the fact, they bear the name of *Lepidostrobi.* The above figure represents *Lepidostrobus variabilis.* [LEPIDOSTROBUS.]

Lepidodendra are usually quoted as an instance of ancient species belonging to the same genus as modern plants of very humble stature (the existing *Lycopodia*, although they acquire sometimes the length or height of three or four feet, are always more like mosses than trees), having arrived at gigantic dimensions in the remote ages when coal was deposited. This is the opinion of M. Adolphe Brongniart and Dr Joseph Hooker, who have both studied this subject carefully. Dr. Lindley has however expressed the opinion that the *Lepidodendra* are allied to the *Coniferæ.* He argues, in the first place, that there is no certainty whatever that the most gigantic *Lepidodendra* were not fir trees, analogous to *Araucaria;* a conjecture which is rendered the more probable by Mr. Nicol's discovery that some of the specimens of fossil coniferous wood are nearly identical with the wood of that genus. Now, the Norfolk Island Pine, which is a species of *Araucaria*, is one of the largest of known trees. In the second place, it is asserted that *Lepidodendron Harcourtii* is not a Lycopodiaceous plant at all, but an extinct genus, intermediate in organisation between *Coniferæ* and *Lycopodiaceæ*, connecting Gymnosperms and Acrogens more directly and satisfactorily than any known plant. Dr. Lindley admits that with regard to the small species of *Lepidodendron*, it is more probable that they belonged to the genus *Lycopodium;* but there is nothing remarkable in their stature.

Ferns are the most abundant of all plants in the shale of the coal, almost every yard of it being more or less marked by their impressions, and very often containing them in great multitudes. It has been estimated that of the vegetable remains belonging to the Coal Flora, one-half at least of the species are ferns. They are in most cases destitute of fructification, so that they cannot be arranged according to the system in use for recent species; and consequently M. Adolphe Brongniart, the great writer upon these subjects, has divided them into genera characterised chiefly by the way in which the veins are disposed. The number of ferns renders it convenient that some such classification should be formed, and M. Brongniart's plan has been adopted by all other writers. It is no part of our object to go into such details in this place, but it will be useful to many of our readers to know what the differences are between some of the most common of these fossil genera. Such are the following:—

Pecopteris consists of species whose leaves are once, twice, or thrice pinnated, with the leaflets either adhering by the whole breadth of their base, or by the centre only. The midrib runs quite through to the point, and the veins are planted upon it somewhat perpendicularly.

Pecopteris lonchitica, a little magnified.

Neuropteris has leaves divided like those of *Pecopteris*, but the midrib does not reach the apex of the leaflets; on the contrary, it divides off right and left into veins, and gradually disappears.

Neuropteris gigantea.

Odontopteris has leaves like the last, but its leaflets adhere to the stalk by their whole base; there is no midrib; and the veins spring side by side at once from the base of the leaflet, passing onwards towards the point.

Odontopteris Brardii.

Sphenopteris has twice or thrice pinnatifid leaves; the leaflets are narrowest at the base, and the veins generally arranged as if they radiated from the base; the leaflets are more frequently wedge-shaped than any other figure.

Sphenopteris artemisiæfolia, magnified.

Lonchopteris has the leaves several times pinnatifid, and the leaflets more or less united to one another at the base; there is a distinct midrib, and the veins are reticulated.

Lonchopteris Bricii.

Cyclopteris has the leaves simple, and either altogether undivided or only lobed at the margin; they are more or less orbicular, and are filled with veins radiating from the base; there is no midrib. Specimens of this genus are common in ironstone nodules.

Cyclopteris orbicularis.

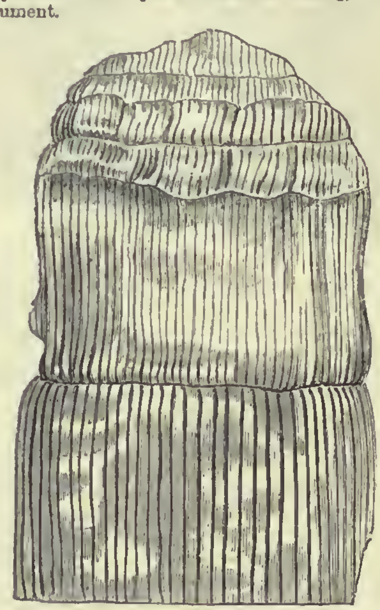
Schizopteris is like the last, except that the leaf is deeply divided into numerous unequal segments, which are usually lobed and taper-pointed.

Under the name of *Caulopteris* are comprehended all the kinds of stems of tree-ferns. They are found in the form of short, round, or compressed truncheons, marked externally by oblong scars of considerable size, much wider than the spaces that separate them, and having their surface irregularly interrupted by projecting points. Such appearances are owing to the manner in which the woody parts of the leaf when fresh were connected with the stem. The fragments to which this name is given no doubt belong to leaves bearing other names; but as the stems and leaves are never found united, it is impossible to identify them. Remains of tree-fern stems are of such rare occurrence that up to the present time not more than two or three specimens have been found in the rich coal-fields of Great Britain.

Dr. Joseph Hooker observes, with regard to the species of fossil ferns, that the characters on which many of them have been founded are quite insufficient to prove them distinct. He shows that amongst recent ferns the presence of the fructification is alone sufficient to show the identity of forms that, according to the method of procedure amongst fossil ferns, would be widely distinct.

3. *Coal Plants with which no existing Analogy has been satisfactorily traced.*

Calamites are fossils found in short, jointed, cylindrical, or compressed fragments, with channels furrowed in their sides, and sometimes partially surrounded by a bituminous coating, the remains of a cortical integument.



Calamites dubius.

They were originally hollow, but the cavity is usually filled up with the substance into which they themselves are converted. They were separable at their articulations, and, when broken across at that part, show a number of striæ originating in the furrows of the sides, and turning inwards towards the centre of the stem, which however they do not reach. It is not known whether this structure was connected with an imperfect diaphragm stretched across the hollow of the stem at each joint, or whether it merely represents the ends of woody plates of which the solid part of the stem was composed. Their extremities have been discovered either to taper gradually to a point, or to end abruptly, the intervals becoming shorter and smaller. The latter are believed to have been the root-ends of these plants, the others the extremity of their branches. Various speculations upon the nature of these plants are to be found in M. Adolphe Brongniart's works, and in Lindley and Hutton's 'Fossil Flora.' The former botanist concludes that they were plants allied to *Equisetum*, only of a more gigantic stature. Later botanists, on the contrary, adduce what they consider ample evidence to show the supposition that *Calamites* were analogous to *Equiseta* to be unfounded; and that they more probably were a race of plants which have now become extinct. It is particularly urged that the presence of bark in *Calamites*, the existence of which M. Adolphe Brongniart admits, is quite conclusive against these plants being related to the *Equisetaceæ*. Dr. Hooker also points out the absence of siliceous matter in the *Calamites*, a substance always found to be present in recent *Equisetaceæ*.

Stigmaria is one of the most common vegetable forms in the coal formation; not a mine is opened, nor a heap of shale thrown out, but there occur fragments of an irregularly-compressed roundish form, apparently portions of a stem, marked externally with small cavities in the centre of slight tubercles arranged irregularly, but somewhat in a quincuncial manner. The axis of these fragments is often hollow, or different in texture from the surrounding part. From the tubercles arise long ribbon-shaped bodies, said to have been traced to the length of twenty feet. Although for a long time regarded as an independent plant, there is now no longer any doubt that *Stigmaria* is the root of *Sigillaria*. In various places specimens of *Sigillaria* have been found standing upright *in situ*, with the *Stigmaria* proceeding from it as roots.

Stigmaria ficoides.

Sigillaria comprehends all those columnar gigantic stems which occur commonly in the sandstone of the coal in an erect or nearly erect position, but which are prostrate and crushed flat in the coal-shale, and which are marked by flutings with a single row of small scars between them. In diameter they vary from 6 to 36 inches, and they must have sometimes been full 40 or 50 feet high.

It is believed, from the very compressed state of many specimens, that these plants must have been of a soft nature, and, from the general absence of scars of large size, that they must have been very little branched.

Of the foliage of *Sigillaria* little or nothing is known. The scars, especially in the larger species, are much too broad to be regarded as the point of attachment of leaves such as may be supposed to have been the case in *Lepidodendron*. The great mass of the stems of *Sigillaria* seems to have been of a soft and succulent character, but the remains of a central column of a denser texture are sufficiently obvious in many of the upright stems. These have been called *Endogenites*. "That this slender column," says Dr. Hooker, "represented all the vascular tissue of this plant, I cannot doubt from examination of *Stigmaria*, whose vascular column often assumes the same appearance."

The affinities of these plants have been variously estimated. Artis, Lindley, Hutton, and Corda, have referred them to *Euphorbiaceæ*; Schlotheim to Palms; Von Martius to *Cactaceæ*; Sternberg to Ferns; Brongniart to *Cycadaceæ*. Dr. Hooker, regarding *Sigillaria elegans* as their type, places them not far from *Lycopodiaceæ*, and near to *Lepidodendron*. "That it was," he says, "of much completer structure and higher organisation than either, is incontestable; but the indications of a relationship with any individual group higher in the series, or with *Cycadeæ* in particular, appear to me far too feeble to justify our considering it as tending to unite these two natural orders." It is a plant which must be considered as belonging to the great family of Ferns, displaying a relationship, though only of analogy, to *Cycadeæ* in one point and to *Euphorbiaceæ* and *Cactaceæ* in others."

Sigillaria reniformis.

Asterophyllites are very common plants, with narrow pointed whorled leaves, which vary in figure and in size, but which, together with the slenderness of the stem to which they belong, give the plants much the appearance of the modern genus *Galium*. They present however no further affinity to Exogenous Plants than this analogy of form.

Sphenophyllum, with many of the characters of the last genus, has broad wedge-shaped leaves, the veins of which are forked. That circumstance has led to the notion that it was related to Ferns, especially to the genus *Marsilea*.

Sphenophyllum Schlotheimii. Asterophyllites foliosus.

Such are the more common of the plants whose remains are traced in the coal-measures. One of the first things which strikes us in casting the eye on the list is the little variety of form apparent in the old flora. Instead of the infinite diversity of plants which are contained in a modern forest, nothing here presents itself except fir-trees, ferns, and a small number of species whose nature is unknown. Not a trace is found of grasses, or the numerous herbs and shrubs that are now met with in all regions clothed with vegetation; and of the vast class of Exogens not one authentic instance occurs. Ferns, too, would seem to have constituted in themselves one-half of the entire Flora, and yet it is only in a few rare cases that they have been met with in a state of fructification. These circumstances have led to the hasty inference that in the beginning nature was in reality but little diversified; that a few forms of organisation of the lower kind only were all that clothed the face of the earth; and that it was only in after-ages that nature assumed her many-coloured ever-varying robe. And yet it has been at the same time admitted that in those early days vegetation was more luxuriant and vigorous than at the present hour. It is not a little singular that the true explanation of this circumstance should not have been hit upon without any direct experiment having been instituted for the purpose of demonstrating how it is really to be explained; for, considering that all geologists are of accord in the opinion that the plants which formed coal were for a period of some duration floating in water, a partial destruction of them might easily have been supposed to be the result. Professor Lindley has proved that plants are capable of enduring suspension in water in very different degrees, some resisting a long suspension almost without change, others rapidly decomposing and disappearing. One hundred and seventy-seven plants were thrown into a vessel containing fresh water; among them were species belonging to the natural orders of which the flora of the coal-measures consists, and also to the common orders, which, from their general dispersion over the globe at the present day, it might have been expected should be found there. In two years one hundred and twenty-one species had entirely disappeared; and of the fifty-six which still remained, the most perfect specimens were those of Coniferous Plants, Palms, *Lycopodiaceæ*, and the like; thus showing in the clearest manner that the meagre character of the Coal Flora may be owing to the different capabilities of different plants of resisting destruction in water. The same experiment accounts for the want of fructification in fossil ferns; for it showed that one of the consequences of long immersion in water is a destruction of the fructification of those plants.

A much more important fact is the presence of certain tropical forms of vegetation, such as tree-ferns, in the coal; and the quasi-tropical character of other species, as *Araucaria*-like *Coniferæ*. This is the more startling when connected with another fact, that the coal-measures of Newcastle are of the same age as those of Newfoundland, and even of Melville Island, in 75° N. lat.

From this it has been inferred that the northern parts of the world enjoyed in remote ages a climate where frost and snow, and the inclement seasons of arctic regions were unknown; that they were at least as hot as equinoctial countries now are; and that the inhospitable hyperborean plains of Melville Island at one time displayed the noble scene of a luxuriant and stately vegetation. Palms, it has been said, were there, and they are the especial and princely denizens of the tropics; tree-ferns occur, and they now only exist in the primeval forests of the torrid zone, haunting their deepest recesses, breathing a damp and equable atmosphere, and living, like vegetable eremites, without even a parasite to fix itself upon their trunks and keep them company. *Stigmariæ*, *Sigillariæ*, and even *Calamites* have been enlisted in the cause of this theory, notwithstanding that no one can say what they may have been. And in confirmation of all this, the preponderance of ferns has been appealed to as having its parallel nowhere except in the hottest and dampest islands of Polynesia.

In opposition to this view it has been asserted that the presence of these tropical forms of vegetation in northern latitudes is no proof of what the climate in which they were deposited formerly was, because they may have been drifted to their present situations by currents. The perfect state of many of the remains offers however great difficulties in the way of this supposition; for although they are very much broken, yet the angles of most fossil plants are by no means water-worn, and in *Sigillariæ*, &c. are as sharp as they ever were. Nor is the state of those tropical stems and fruits, which in modern times reach the coasts of Ireland and Norway, at all like that of the buried plants of the coal-measures.

Another difficulty in the way of admitting a high temperature in northern regions in former days is suggested by considering the duration of the days. Without a diurnal change of light and darkness plants cannot exist; absence of light blanches them, by the accumulation of undecomposed carbonic acid; absence of darkness destroys or dwarfs and deforms them, by the incessant decomposition of their carbonic acid. Now, however this may be reconciled with a country like England, in which the winter days are of moderate length, it is less reconcilable with the northern parts of North America, and not at all with Melville Island, in which there are 94 days when the sun is never above the horizon, and 104 days that he never sets. With regard to the transportation of the coal, the absence of indications of washing, and the frequent occurrence of upright stems, seem to lead to the conclusion that in most instances the plants which formed coal have grown at the most within a few hundred miles of the places where they are now deposited, and probably in their very vicinity. From this statement we must at present except the coal of Melville Island; for although the vegetable impressions in the English coal-measures are by no means water-worn, yet those in the British Museum from Melville Island are so rubbed and damaged that there is no doubt they have travelled long distances before they were deposited.

The opinion that the plants of the coal-measures afford evidence that the climate where they grew must have been tropical, has been founded upon three classes of facts, each of which requires separate examination; the one, the excessive development of certain forms of vegetation; another, the presence of the remains of palms and tree-ferns, which are usually considered incapable of existing unless in a tropical atmosphere; the third, the excessive disproportion of ferns to other plants.

With regard to the first argument it may be answered, that we know too little of the real nature of the *Sigillariæ*, *Lepidodendra*, *Calamites*, and other plants, to form a correct opinion. It is almost certain that all these plants are in reality destitute of living analogies; and therefore as we do not know what they were, we have no means of judging what kind of climate they required. Supposing that some of the *Lepidodendra* were closely allied to the modern genus *Araucaria*, as is highly probable, yet that fact does not afford any proof of a tropical climate; for *Araucaria Dombeyi* now inhabits the cold mountains of southern Chili, and is at this day uninjured in the severest of our English winters; while *Cunninghamia Sinensis*, and species of *Callitris* or *Dacrydium*, with which other remains of *Lepidodendra* may be compared, although not European, are by no means of tropical habits, but are found on the mountains of New Zealand and Van Diemen's Land, where they are exposed to a far from temperate climate. Moreover, *Salisburia adiantifolia*, which would certainly be considered a tropical form of *Coniferæ*, if found in an extinct state only, is one of the hardiest of trees, and a native of the rigorous climate of Japan. But even supposing *Sigillariæ* could be found to have been succulent plants, allied to *Cactaceæ* or *Euphorbiaceæ*, as some think, still no real evidence of their having required a tropical climate for their development would be afforded by them, because there is nothing in the mere organisation of succulent plants which unfits them for cold climates. A capability of enduring cold is something immaterial and independent of organisation, about which nothing can be judged à priori; for turnips, cabbages, Jerusalem artichokes, house-leek, and many other hardy plants are in parts as succulent as *Cactaceæ*. All arguments therefore to prove that the north of Europe was formerly tropical, deduced from the presence of such plants as those now mentioned, are inadmissible.

Nor is the argument derived from the presence of palms and tree-ferns of much greater force. In the first place, we have seen that there is really no grounds for believing that palms existed; and as for tree-ferns, we have them in New Zealand, and especially on the south side of Van Diemen's Land, where the mean temperature probably does not exceed 54° Fahrenheit. So that, all things considered, it is by no means safe to take the remains of these plants as good evidence of a tropical climate, or of a climate materially unlike that which we now experience.

The only remaining argument to be considered is that derived from the great preponderance of ferns in the Coal Flora. It is said by Adolphe Brongniart, that as it is only in damp tropical regions that we now find ferns equal in the number of their species to all the species of other plants, and as this same proportion is found in the Coal Flora, that therefore the climate under which the Coal Flora was produced must have been damp and tropical. But as, by the experiment already mentioned, it was shown that when a given number of plants of entirely different habits are plunged into the same vessel of water, by far the greater part is decomposed before ferns begin to be affected, it is obvious that no estimate of what the proportion of ferns to other plants really was, can now be formed; and consequently this argument also falls to the ground.

From these facts it appears then that we may safely adopt the following conclusions:—

1. That coal is of vegetable origin.
2. That at the period of its deposit, the earth was covered with a rich vegetation, of which only a small portion has been preserved; and that of this portion all the species and several of the races are totally unknown at the present day.
3. That the climate may possibly have been something milder than it now is, but that there is no evidence in the vegetable kingdom to show that it was materially different from that of the present day.

The following is a list of the species of plants that have been found in the coal-measures of Great Britain, as given by Professor Tennant in his 'Stratigraphical List of British Fossils.' Very few species indeed appear to have been found in other parts of the world that are not found in Great Britain:—

Alethoptheris Cistii, Gopp.
A. heterophylla, Gopp.
A. Lindleyana, Presl.
A. lonchitidis, Sternb.
A. Mantelli, Gopp.
A. nervosa, Gopp.
A. Sauverii, Gopp.
A. Serra, Gopp.
A. Serlii, Gopp.
A. urophylla, Gopp.
A. vulgatior, Sternb.
Anabathra pulcherrima, Lindley.
Annularia fertilis, Sternb.
A. longifolia, Brong.
Antholithes anomalus, Morris.
A. Pitcairnia, Lindley.
Aphlebia adnascens, Presl.
Artisia approximata, Brong.
A. distans, Brong.
A. transversa, Presl.
Aspidiaria Anglica, Presl.
A. confluens, Presl.
A. cristata, Presl.
A. quadrangularis, Presl.
A. undulata, Presl.
Asterophyllites comosus, Lindley.
A. foliosus, Lindley.
A. galioides, Lindley.
A. jubatus, Lindley.
A. rigidus, Lindley.
Bechera charæformis, Sternb.
B. grandis, Sternb.
Bornia equisetiformis, Sternb.
Bruckmannia grandis, Lindley.
B. longifolia, Sternb.
B. rigida, Sternb.
B. tenuifolia, Sternb.
B. tuberculata, Sternb.
Calamites approximatus, Brong.
C. cannæformis, Schlot.
C. Cistii, Brong.
C. decoratus, Brong.
C. dubius, Brong.
C. inæqualis, Brong.
C. Lindleyi, Sternb.
C. nodosus Schlot.

C. pachyderma, Brong.
C. ramosus, Brong.
C. Steinhaueri, Brong.
C. Suckowii, Brong.
C. undulatus, Brong.
C. varians, Sternb.
C. verticillatus, Lindley.
Cardiocarpon acutum, Brong.
Carpolithes alatus, Lindley.
C. helicteroides, Morris.
C. marginatus, Artis.
C. sanmodes, Morris.
Caulopteris Phillipsii, Lindley.
C. primaeva, Lindley.
Chondrites Prestricii, Morris.
Cyclopteris dilatata, Lindley.
C. flabellata, Brong.
C. oblata, Lindley.
C. obliqua, Brong.
C. orbicularis, Brong.
C. reniformis, Brong.
Cyperites bicarinata, Lindley.
Favularia tessellata, Lindley.
F. nodosa, Lindley.
Flabellaria borassifolia, Sternb.
Halonia disticha, Morris.
H. gracilis, Lindley.
H. regularis, Lindley.
H. tortuosa, Lindley.
H. tuberculosa, Lindley.
Lepidodendron Bucklandi, Brong.
L. elegans, Brong.
L. Harcourtii, Lindley.
L. longifolium, Brong.
L. obovatum, Sternb.
L. plumarium, Lindley.
L. selaginoides, Sternb.
L. Serlii, Presl.
L. Sternbergii, Brong.
Lepidophyllum intermedium.
L. lanceolatum.
L. trinerve, Lindley.
Lepidostrobus comosus, Lindley.
L. ornatus, Lindley.
L. pinaster, Lindley.
L. variabilis, Lindley.
Lycopodites cordatus, Sternb.
L. phlegmarioides, Sternb.
Megaphyton Allani, Presl.
M. approximatum, Lindley.
M. distans, Lindley.
Myriophyllites gracilis, Artis.
Neuropteris acuminata, Brong.
N. acutifolia, Brong.
N. angustifolia, Brong.
N. attenuata, Lindley.
N. cordata, Brong.
N. flexuosa, Sternb.
N. gigantea, Sternb.
N. heterophylla, Brong.
N. Loshii, Brong.
N. macrophylla, Brong.
N. rotundifolia, Brong.
N. Soretii, Brong.
N. tenuifolia, Sternb.
Noeggerathia flabellata, Lindley.
Odontopteris Britannica, Presl.
O. Lindleyana, Sternb.
O. obtusa, Brong.
O. Schlotheimii, Brong.
Pecopteris abbreviata, Brong.
P. adiantoides, Lindley.
P. arborescens, Brong.
P. Bucklandi, Brong.
P. dentata, Brong.
P. heterophylla, Lindley.
P. laciniata, Lindley.
P. Miltoni, Brong.
P. muricata, Brong.
P. obliqua, Brong.
P. oreopteridis, Brong.
P. plumosa, Brong.
P. pteroides, Brong.
P. repanda, Lindley.
P. villosa, Brong.
Peuce Withami, Lindley.
Pinites ambiguus, Witham.
P. anthracina, Lindley.
P. Brandlingi, Lindley.
P. carbonaceus, Witham.
P. medullaris, Lindley.
P. Withami, Lindley.
Pinnularia capillacea, Lindley.
Pitys antiqua, Witham.
P. primaeva, Witham.
Poacites cocoina, Lindley.
Rhodea dissecta, Presl.
R. furcata, Presl.
Sagenaria aculeata, Presl.
S. caelata, Brong.
S. ophiura, Brong.
Selaginites patens, Brong.
Sigillaria alternans, Lindley.
S. catenulata, Lindley.
S. contracta, Brong.
S. elongata, Brong.
S. flexuosa, Lindley.
S. Knorrii, Brong.
S. leioderma, Brong.
S. laevigata, Brong.
S. Murchisoni, Lindley.
S. notata, Brong.
S. oculata, Lindley.
S. ornatum, Brong.
S. reniformis, Brong.
S. Saullii, Brong.
Sphenophyllum dentatum, Brong.
S. emarginatum, Brong.
S. erosum, Lindley.
S. Schlotheimii, Brong.
Sphenopteris acutifolia, Brong.
S. adiantoides, Lindley.
S. affinis, Lindley.
S. artemisaefolia, Sternb.
S. bifida, Lindley.
S. caudata, Lindley.
S. Conwayi, Lindley.
S. crassa, Lindley.
S. crenata, Lindley.
S. cuneolata, Lindley.
S. dilatata, Lindley.
S. elegans, Brong.
S. excelsa, Lindley.
S. gracilis, Brong.
S. Hibbertii, Lindley.
S. latifolia, Brong.
S. linearis, Sternb.
S. macilenta, Lindley.
S. multifida, Lindley.
S. obovata, Lindley.
S. polyphylla, Lindley.
S. tenella, Brong.
S. trifoliata, Brong.
Stigmaria ficoides, Brong.
Trigonocarpum Dawesii, Lindley.
T. Noeggerathii, Brong.
T. oblongum, Lindley.
T. olivaeforme, Lindley.
T. ovatum, Lindley.
Ulodendron Allani, Buckl.
U. Conybearii, Buckl.
U. Lucasii, Buckl.
U. majus, Lindley.
U. minus, Lindley.
Walchia piniformis, Schlot.

More recent investigations have enlarged this list: at the same time it should be remembered, that there is considerable doubt as to whether all these forms should be regarded as species. The following table drawn up by Mr. Pattison in his chapters on Fossil Botany will give an idea of the comparative abundance and diversity of the plants of the Coal period in Great Britain as compared with that of any other geological period :—

Formation.	Plants found Fossil.	
	Genera.	Species.
Tertiary	21	120
Chalk	3	4
Greensand	7	9
Wealden	8	11
Oolite	34	89
Lias	7	10
New Red-Sandstone	6	6
Coal-Measures	58	279
Devonian and Silurian	1	1
	145	529

COASSUS. [Cervidae.]

COBAEA'CEAE, a small natural order of Plants, separated by D. Don from *Polemoniaceae*. It has a leafy 5-cleft equal calyx; an inferior campanulate regular 5-lobed corolla, imbricate in aestivation; 5 unequal stamens rising from the base of the corolla, with 2-celled compressed anthers; superior 3-celled ovary, surrounded by a fleshy annular hypogynous disc; the ovules several, ascending; simple style; trifid stigma; the fruit capsular, 3-celled, 3-valved, with a septicidal dehiscence; the placenta very large, 3-cornered in the axis, its angles touching the line of dehiscence of the pericarpium; the seeds flat, winged, imbricated in a double row, their integument mucilaginous, fleshy albumen, and a straight embryo; the cotyledons foliaceous; the radicle inferior. The species are climbing shrubs, with alternate pinnated leaves, the common petiole being converted into a tendril. G. Don observes that this order is readily distinguished from *Bignoniaceae* and *Pedalineae* by the flowers being regular and pentandrous, and in the presence of albumen in the seeds; and from *Polemoniaceae* by habit and its winged seeds. Lindley places the genus *Cobaea*, which is the only one of the order, in *Polemoniaceae*, and says, "The differences of importance between the one and the other appear to consist in the former having an unusually large lobed disc, a septicidal dehiscence, and climbing habit; distinctions, I fear, of too little moment to be admitted as of ordinal value."

There are two species of *Cobaea*, *C. scandens* and *C. lutea*: the former has large campanulate flowers, with a short tube of a dark dirty purple colour; the latter has yellowish flowers, about half the size of those of *C. scandens*. The *C. scandens* is a great favourite in our gardens, and is a rapid-growing and abundant-flowering climber. It will grow in the open air in summer, and should be trained against a south wall, or against a house, when it flowers profusely. It is adapted for conservatories and greenhouses. It may be propagated by seeds or cuttings.

(Don, *Dichlamydeous Plants*; Lindley, *Natural System*.)

COBALT ORES. Cobalt is not found in the native state, and its ores, though not numerous, require a more minute examination than they have hitherto received. We shall notice those which are best known.

Bright White Cobalt or *White Cobalt* occurs crystalline and massive; the primary form is a cube, the planes of which are usually striated; colour silver-white; streak grayish-black; lustre metallic; hardness 5·5, yielding with difficulty to the knife, and not very frangible; specific gravity 6·3 to 6·5; fracture uneven; cleavage parallel to the faces of the cube; before the blowpipe on charcoal gives arsenical fumes, and tinges borax of a deep blue.

It is found in fine crystals at Tunaberg in Sweden, in Norway, Silesia, and Cornwall.

It is met with also amorphous, arborescent, botryoidal, and stalactitic. The following is the analysis of the crystals from Tunaberg by Klaproth and Stromeyer :—

Cobalt	44	36·7
Arsenic	55	49·0
Sulphur	00·5	5·6
		6·5
	99·5	97·8

Tin-White Cobalt or *Hard White Cobalt* occurs massive and crystallised in cubes and octohedrons; colour tin-white, but sometimes externally tarnished; fracture fine-grained and uneven; lustre metallic; it yields with difficulty to the knife, and is hard and brittle; specific gravity variously stated, from 6·74 to 7·7; yields arsenical vapour when heated with the blowpipe, and tinges borax deep blue.

The massive is amorphous, arborescent, botryoidal, &c. The amorphous occurs in Cornwall, and the crystallised at Skutterud in Norway. Analysis of the crystals by Stromeyer :—

Cobalt	33·10
Arsenic	43·46
Iron	3·23
Sulphur	20·00
	99·79

Gray Cobalt occurs massive and crystallised; primary form a cube; colour grayish tin-white; streak grayish-hlack; lustre metallic; hardness 5·5; specific gravity 6·466; fracture uneven; cleavage indistinct. The massive occurs amorpbous and reticulated. It is found principally at Schneeberg in Saxony, and is used in the mauufacture of smalt.

Earthy Cobalt occurs massive, amorphous, hotryoidal, pulverulent, &c.; colour yellowish-brown and bluish-hlack; specific gravity 2 to 2·4; tbe fracture of tbe massive is earthy and dull, but polished by friction, and yields to the knife readily; when heated on charcoal gives an arsenical odour, and a deep blue colour with borax: it is found in Hesse, Saxony, Bohemia, and also in Cheshire and Cornwall.

Sulphuret of Cobalt occurs yellowish-wbite and steel-gray; streak gray; it is amorphous or botryoidal, and externally brilliant; fracture uneven. According to Hitsinger it consists of—

Cobalt	43·2
Copper	14·4
Iron	3·53
Sulphur	38·50
Earthy Matter	·33
	99·96

Arseniate of Cobalt—Cobalt Bloom—Red Cobalt—occurs fibrous, massive, and crystallised; primary form an oblique rhombic prism; colour various shades of red passing into crimson; sometimes grayish; translucent, transparent; it is soft, light, and flexible; specific gravity 2·948; the massive variety amorphous, botryoidal; structure fibrous, radiating; before the blow-pipe emits arsenical odours, and tinges borax blue: it occurs in Saxony, Bohemia, Scotland, and Cornwall, &c.

Analysis by Bucholz:—

Arsenic Acid	37·9
Oxide of Cobalt	39·2
Water	22·9
	100

Sulphate of Cobalt—Red Vitriol—is of a pale rose-red colour, and occurs investing other minerals, in small masses and in stalactites; the masses are semi-transparent and crystalline; it is soluhle in water; translucent; lustre vitreous, often dull externally: it occurs among the mining heaps near Hanau and in Salzburg.

COBALTINE, an Arsenical Ore of Cobalt containing sulphur. It is of a silver-white colour inclining to red. It is found in Sweden, Norway, Siberia, and Cornwall.

COBITIS, a genus of Fishes belonging to the Abdominal *Malacopterygii* and family *Cyprinidæ*. This genus includes tho Loaches, fishes generally of diminutive size, which may be distinguished by tbeir having the head small; mouth but slightly cleft, without tecth, and furnished with harbules on the upper lip; body elongated, covered with small scales, and invested with a mucous secretion; ventral fins situated far back, dorsal fin placod above them; gill-openings small; branchiostegous rays tbree in number.

C. barbatula, the Loach, Loche, or Beardie, is common in most of our running waters. It is about 4 inches in length, and of a dirty pale-yellow colour, mottled with hrown; its upper lip is furnished with six barbules, one of which springs from each corner of the mouth, and the otbers are situated on the fore part.

Like fishes in general which have barbules, the Loaches feed at the bottom of the water. The species above described spawns in March or early in April, and is very prolific.

C. tænia (Linn.), the Spined Loach, or Groundling, is a far less common species than the above; its form is more compressed; the harbules are very short, and consequently less conspicuous: tbe principal character however consists in its having two spines, one before each eye. From tbis character and some other differences of minor importance, tbis fish, and several others baving tbe same structure, have been separated from tho true loaches, and now constitute the genus *Botia* of Mr. Gray.

The Loachos aro extremely restless during stormy weather, when they generally riso to the surface of tho water, wbich from their restlessness is kept iu constant agitation.

COB-NUT or HOG-NUT, a name given in the West Indies to the fruit of a species of *Omphalea*. [OMPHALEA.] It is also applied to the larger forms of the cultivated Hazel-Nut. [CORYLUS.]

COBRA. [VIPERIDÆ.]

COCA, the dried leaf of *Erythroxylon Coca*, is one of those stimulating narcotics which belong to tbe same class with tobacco and opium, but is more remarkable than either of tbem in its effects upon the human system. The plant is found wild in Peru, according to Pöppig, in the environs of Cuchero, and on the stony summit of the Cerro de San Cristohal. It is cultivated extensively in the mild hut very moist climate of tho Andes of Peru, at from 2000 to 5000 feet above tho sea: in colder situations it is apt to be killed, and in warmer districts the leaf loses its flavour.

A detailed account of it is given by Pöppig and Sir William Hooker in the 'Companion to the Botanical Magazine,' whence we extract the following information. It forms a shrub from 4 to 8 feet high, the stem coverod with whitish tubercles, which appear to be formed of two curved lines set face to face. The leaves are oblong, acute at each end, 3-ribbed, on short petioles, with a pair of intrapetiolary brown acute stipules. Flowers in little fascicles; peduncles sharply angled; calyx 5-cleft; petals obloug, concave, wavy, with a jagged plaited membrane arising from within their hase; stamens 10; styles 3; fruit a 1-seeded oblong drupe.

Erythroxylon Coca.

Tho effects of this drug are said to be of the most pernicious nature, exceeding even opium in tho destruction of mental and bodily powers. The coca leaf is chewed hy the Peruvians, mixed with finely-powdered chalk, and brings on a state of apathy and indifference to all surrounding objects, the desire for which increases so much with indulgence in it, that a confirmed Coca-chewer is said never to have been reclaimed. Pöppig describes such a person in his usual graphic manner:—

"Useless for every active pursuit in life, and the slave of his passions, even more than the drunkard, he exposes himself to tbe greatest dangers for the sake of gratifying this propensity. As tbe stimulus of the coca is most fully developed when the body is exhausted with toil, or the mind with conversation, the poor victim then hastens to some retreat in a gloomy native wood, and flinging himself under a tree, remains stretcbed out tbere, heedless of night or of storms, unprotected by covering or by fire, uncouscious of the floods of rain and of the tremendous winds which sweep the forest; and after yielding himself, for two or three entire days, to the occupation of cbewing coca, returns home to his abode, with trembling limbs and a pallid countenance, the miserable spectacle of unnatural enjoyment. Whoever accidentally meets the Coquero under such circumstances, and hy speaking interrupts the effect of this intoxication, is sure to draw upon himself the hatred of the half-maddened creature. Tbe man who is once seized with the passion for this practice, if placed in circumstances which favour its indulgence, is a ruined being. Many instances were related to us in Peru, wbere young people of the best families, by occasionally visiting the forests, have begun using the coca for the sake of passing the time away, and, acquiring a relish for it, have, from that period, been lost to civilisation; as if seized by some malevolent instinct, they refuse to return to their homes; and, resisting the entreaties of their friends, who occasionally discover the haunts of these unhappy fugitives, either retire to some more distant solitude, or take the first opportunity of escaping when they bave been brought back to the towns."

The immoderate addiction of the Peruvians to the use of this drug is such tbat their forests bave long since ceased to be able to supply tbeir wants; and tho cultivation of the plant has been carried to a very great extent, not only under the Incas, but beneath the local government of the Spaniards, who seem to bave been no more able to resist the temptation of a large revenue from the mouopoly of this article than European nations from tbe consumption of ardent spirits. It is said that in the year 1583 the government of Potosi derived a sum of not less than 500,000 dollars from the consumption of 90,000 to 100,000 baskets of the leaf. The cultivation of Coca is therefore an important feature in Peruvian husbandry, and, it is added, so lucrative, that a coca plantation, whose original cost and current expenses amounted to 2500 dollars during tbe first 20 months, will, at tbo end of 10 months more, bring a clear income of 1700 dollars. Pöppig states that Coca has now become a sort of necessary evil; that thousands of persons would be deprival of their means of existence if its consumption were put a stop to; and that the value of it in Peru and Bolivia amounts to above two and a half millions of dollars a year.

The exciting principle of the Coca has not yet been inquired into. It is stated by Pöppig to be of so very volatile a nature that leaves only twelve months old become perfectly inert and good for nothing. "Large heaps of the freshly-dried leaves, particularly while the warm rays of the sun are upon them, diffuse a very strong smell, resembling that of hay in which there is a quantity of melilot. The natives never permit strangers to sleep near them, as they would suffer violent headaches in consequence. When kept in small portions, and after a few months, the coca loses its scent and becomes weak in proportion. The novice thinks that the grassy smell and fresh hue are as perceptible in the old state as when new, and this is to be expected with the Peruvian, who never uses it without the addition of burnt lime. Without this, which always excoriates the mouth of a stranger, the natives declare that coca has not its true taste, a flavour, by the bye, which can only be detected after a long use of it. It then tinges green the carefully-swallowed spittle, and yields an infusion of the same colour. Of the latter alone I made trial, and found that it had a flat grass-like taste, but I experienced the full power of its stimulating principles. When taken in the evening it was followed by great restlessness, loss of sleep, and generally uncomfortable sensations; while, from its exhibition in the morning, a similar effect, though to a slight degree, arose, accompanied with loss of appetite. The English physician, Dr. Archibald Smith, who has a sugar plantation near Huanuco, once, when unprovided with Chinese tea, made a trial of the coca as a substitute for it, but experienced such distressing sensations of nervous excitement that he never ventured to use it again. The Peruvian increases its effects by large doses, utter retirement, and the addition of other stimulating substances. The inordinate use of the coca speedily occasions bodily disease, and detriment to the moral powers; but still the custom may be persevered in for many years, especially if frequently intermitted, and a Coquero sometimes attains the age of fifty, with comparatively few complaints. But the oftener the orgies are celebrated, especially in a warm and moist climate, the sooner are their destructive effects made evident. For this reason the natives of the cold and dry districts of the Andes are more addicted to the consumption of coca than those of the close forests, where, undoubtedly, other stimulants do but take its place. Weakness in the digestive organs, which, like most incurable complaints, increases continually in a greater or less degree, first attacks the unfortunate Coquero. This complaint, which is called 'opilacion,' may be trifling at the beginning, but soon attains an alarming height. Then come bilious obstructions, attended with all those thousand painful symptoms which are so much aggravated by a tropical climate. Jaundice and derangement of the nervous system follow, along with pains in the head, and such a prostration of strength that the patient speedily loses all appetite; the hue of the whites assumes a leaden colour, and a total inability to sleep ensues, which aggravates the mental depression of the unhappy individual who, spite of all his ills, cannot relinquish the use of the herb to which he owes his sufferings, but craves brandy in addition. The appetite becomes quite irregular, sometimes failing altogether, and sometimes assuming quite a wolfish voracity, especially for animal food. Thus do years of misery drag on, succeeded at length by a painful death."

(Pöppig, *Reise in Chile, &c.*, vol. ii.; Hooker, *Companion to Bot. Mag.* i. and ii.)

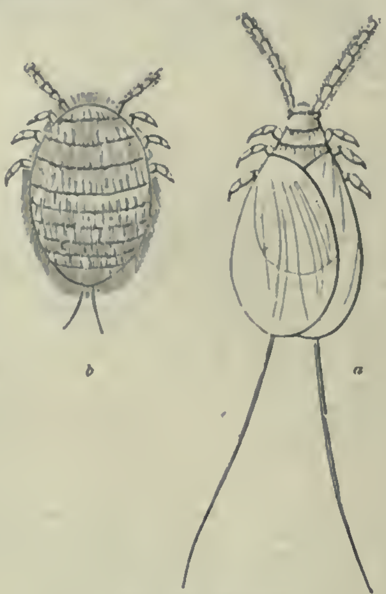
COCCIDÆ (Leach), *Gallinsecta* (Latreille), a family of Insects placed by Latreille and others at the end of the *Homoptera*. These insects apparently have but one joint to the tarsi, and this is furnished with a single claw. The males are destitute of rostrum, and have two wings, which when closed are laid horizontally on the body: the apex of the abdomen is furnished with two setæ. The females are apterous, and provided with a rostrum. The antennæ are generally filiform or setaceous.

The insects belonging to this family live upon trees or plants of various kinds: they are of small size, and in the larva state have the appearance of oval or round scales, hence they are called Scale Insects. They are closely attached to the plant or bark of the tree they inhabit, and exhibit no distinct external organs. At certain seasons, when about to undergo their transformation, they become fixed to the plant, and assume the pupa state within the skin of the larva. The pupa of the males has their two anterior legs directed forwards, and the remaining four backwards; whereas in the females the whole six are directed backwards. When the males have assumed the winged or imago state they are said to issue from the posterior extremity of their cocoon.

In the spring time the body of the female becomes greatly enlarged, and approaches more or less to a spherical form. In some the skin is smooth, and in others transverse incisions or vestiges of segments are visible. It is in this state that the female receives the embraces of the male, after which she deposits her eggs, which are extremely numerous. In some the eggs are deposited by the insect beneath her own body, after which she dies, and the body hardens and forms a scale-like covering, which serves to protect the eggs until the following season, when they hatch. The females of other species cover their eggs with a white cotton-like substance, which answers the same end.

Upwards of thirty species of the family *Coccidæ*, or *Gallinsecta*, are enumerated in Mr. Stephens's 'Catalogue of British Insects;' several of these however have undoubtedly been introduced with the plants they inhabit, and to which they are peculiar.

Many of the exotic *Cocci* have long been celebrated for the beautiful dyes they yield. The *Coccus Cacti* of Linnæus may be mentioned as an instance. The female of this species is of a deep brown colour, covered with a white powder, and exhibits transverse incisions on the abdomen. The male is of a deep red colour, and has white wings.



Coccus Cacti, magnified.
a, the male; *b*, the female.

This insect, which when properly prepared yields the dye called cochineal, is a native of Mexico, and feeds upon a particular kind of Indian fig, which is cultivated for the express purpose of rearing it. [COCHINEAL.]

C. Ilicis, an insect found abundantly upon a small species of evergreen oak (*Quercus coccifera*), common in the south of France and many other parts, has been employed to impart a blood-red or crimson dye to cloth from the earliest ages. ('Introduction to Entomology,' by Kirby and Spence, vol. i. p. 319.)

C. Polonicus is another species which is used in dyeing, and imparts a red colour. It is now chiefly employed by the Turks for dyeing wool, silk, and hair, and for staining the nails of women's fingers. (Kirby and Spence, vol. i. p. 320.)

But we are not only indebted to the *Coccus* tribe for the dyes they yield; the substance called Lac is also procured from one of these insects (the *Coccus Lacca.*) This species inhabits India, where it is found on various trees in great abundance. "When the females of this *Coccus* have fixed themselves to a part of the branch of the trees on which they feed (*Ficus religiosa*, and *F. Indica*, *Butea frondosa*, and *Rhamnus Jujuba*), a pellucid and glutinous substance begins to exude from the margins of the body, and in the end covers the whole insect with a cell of this substance, which when hardened by exposure to the air becomes lac. So numerous are these insects, and so closely crowded together, that they often entirely cover a branch; and the groups take different shapes, as squares, hexagons, &c., according to the space left round the insect which first began to form its cell. Under these cells the females deposit their eggs, which after a certain period are hatched, and the young ones eat their way out." (Kirby and Spence, vol. iv. p. 142.)

C. adonidum, the Mealy Bug, is an insect well known in our hothouses. It attacks vines, pine-apples, and other plants. It is of a reddish colour, and is covered with a white mealy powdery-looking substance—hence its name.

C. Vitis, the Vine-Scale, is another species which does great mischief to vines on account of the rapidity with which it is propagated.

C. Hesperidum is found on orange-trees. *C. Testudo*, the Turtle-Scale, is found on stove-plants exposed to a high temperature.

Many ways are recommended of getting rid of these insects. Brushing them off with cold or lukewarm water, when plants will bear it, is a good plan. Painting with spirits of turpentine, or exposing them to the fumes of turpentine, or tobacco, or sulphur has also been found effectual.

COCCINELLA. [TRIMERA.]

COCCOLITE, a general name for granular varieties of *Pyroxene*. [PYROXENE.]

COCCO'LOBA, a genus of Plants belonging to the natural order *Polygonaceæ*. It has a 5-parted calyx, eventually becoming succulent; the filaments 5, inserted into the base of the calyx, and forming a short ring by their union; the styles 3; stigma simple; the nut 1-seeded, bony, covered with the succulent enlarged calyx; the embryo in the middle of the albumen.

C. uvifera, Sea-Side Grape, has cordate roundish shining leaves. It is a tree 20 feet in height, with flexuose branches. The leaves are very beautiful, being of a full bright glossy green colour, with the principal nerves of a deep red. As the fruit advances to maturity it becomes surrounded by the succulent perianth, which forms an obovate reddish purple berry, not unlike a small pear. The nut in the inside is roundish, very acute, 3-lobed at the base, and attached by the centre. The embryo has foliaceous cotyledons. The leaves, wood, and bark of this plant are powerfully astringent, and a decoction of them is evaporated to form the substance called Jamaica Kino. The astringency depends on the presence of tannin, but there is in addition present in the wood a red colouring-matter which is used as a dye. The wood is also valued for cabinet-work. The fruit is eatable, and is exposed for sale in the West Indian markets, but is not valued much. It is a native of the sea-coasts of most of the West Indian Islands and the adjoining shores of America. There are several other species of *Coccoloba* natives of the West Indies. They are all of them evergreen-trees. They grow freely in a light loamy soil, and ripened cuttings taken off at the joint and placed under a hand-glass in a pot of sand will root freely. They require a stove.

(Loudon, *Encyclopædia of Plants;* Lindley, *Flora Medica.*)

COCCO'STEUS, a genus of Fossil Fishes, with a tuberculated scaly covering, from the Old Red-Sandstone of Gamrie, Cromarty, Caithness, and the Orkney Islands. (Agassiz.)

COCCOTHRAUSTES, a genus of Insessorial Birds belonging to the family *Fringillidæ*. It has the following characters:—Beak conical, very thick at the base, tapering rapidly to the point; culmen rounded; the commissure slightly arched; lower mandible nearly as large as the upper, its cutting edges inflected, and shutting within those of the upper. Nostrils basal, lateral, oblique, oval, nearly hidden by the short feathers at the base of the beak. Wings long, rather powerful, the second and third quill-feathers of nearly equal length and rather longer than the first. Legs with the tarsi short, not exceeding the length of the middle toe, the outer toe longer than the middle one; claws sharp and curved, the hind-toe and claw broad and strong. Tail short and more or less forked.

C. vulgaris, the Hawfinch, Haw Grosbeak, Grosbeak, of the English; Gylfinbraff of the Welsh; Le Grosbec and Pinson Royal of the French; Frogione, Froccione, Frosone, Frisone, Friggione, of the Italians; Kernbeisser, Kirsch Kernbeisser, Kerschfink, Nusbeisser, of the Germans; Appel-Vink of the Netherlanders; *Loxia Coccothraustes* of Linnæus; *Fringilla Coccothraustes* of Temminck; *Coccothraustes vulgaris* of Brisson.

It has the rump, head, and cheeks, red-brown; edging round the bill, space between that and the eye, a line beyond the eye and throat, deep black; a large ash-coloured collar just below the nape; back and greater part of the wings deep brown, but there is an oblique white stripe upon the wing, and beyond it a considerable space of a light whitish colour going off into chestnut; secondary quills as if cut off square at the ends, or, as Edwards says with justice, like the figures of some of the ancient battle-axes, glossed with rich blue, less conspicuous in the female; tail-feathers white within, of a blackish-brown on the external barbs; lower parts of the bird vinous-red; iris pale red (according to Temminck); feet and bill grayish-brown. Length seven inches.

The female is generally like the male, but with the colours much less brilliant.

The young of the year before the moult are very different from the adults and old birds. Throat yellow; face, cheeks, and summit of the head dirty yellowish; lower parts white or whitish; sides marked with small brown streaks, with which all the feathers are terminated. As the young bird advances in age some red vinous feathers appear disposed irregularly upon the belly; the upper parts are of a tarnished brown, spotted with dirty yellowish; bill whitish brown, except at the point, where it is deep brown. (Temminck.)

Mr. Gould ('Birds of Europe') says that in the male the beak and feet in winter are of a delicate flesh-brown, the former becoming in summer of a clear leaden hue, the ends straw-colour, and in some instances white; the top of the head, the cheeks, and rump, of a chestnut-brown. The rest of the description does not differ much from M. Temminck's.

Varieties.—White, yellowish, or grayish. Wings and tail often white. Plumage often variegated with white feathers.

Food, Habits, Reproduction, &c.—Hard seeds and kernels form the principal food of the Grosbeak, but we have seen it feeding on the berries of the hawthorn (whence its name), and shot it when so employed; so that it is probable that the soft part of fruits is not disagreeable to it, although the bill is evidently formed for cracking the stony kernel. Willughby states that it breaks the stones of cherries, and even of olives, with expedition. The stomach of one which he dissected in the month of December was full of the stones of holly-berries. The majority of ornithologists give the Hawfinch credit for forming a nest beautifully constructed of lichens and vegetable fibres, with a lining of feathers and other soft materials. But, according to Mr. Doubleday, who has thrown much light on the history of this bird, and discovered it breeding in Epping Forest in May and June, the nest, which is made in some instances in bushy trees at the height of five or six feet, and in others near the top of firs at an elevation of twenty or thirty feet, is remarkably shallow and carelessly put together, being scarcely deeper than that of the dove. In materials it resembles that of the bullfinch, but is not to be compared with it in neatness and compactness of construction. Eggs, from four to six in number, of a pale greenish-white, varying in intensity, spotted and streaked with greenish-gray and brown. Mr. Gould states that he has known the bird to breed near Windsor, and a few other places; but certainly nowhere so abundantly as on the estate of W. Wells, Esq., at Redleaf, near Penshurst, Kent. This gentleman informed Mr. Gould that he had, with the aid of a small telescope, counted at one time eighteen on his lawn.

Mr. Selby remarks that in the pairing season it probably utters a superior song, as Montagu says that even in winter, during mild weather, he has heard it sing sweetly in low and plaintive notes.

Distribution.—Plentiful in some districts of France; permanent and not uncommon in Italy; common in Germany, Sweden, and part of Russia. In Mr. Selby's 'Illustrations,' and indeed in most other English works, the Hawfinch is noticed as an occasional visitant. Dr. Latham says that "the hawfinch visits us chiefly in winter, but one was shot in the summer months near Dartford, in Kent." He goes on to remark that White records another instance at the same season, and says that it had the kernels of damsons in its stomach, "These," continues Dr. Latham, "might possibly have bred here. though we have no authority for its ever being the case." This authority now exists in the observations of Mr. Doubleday. "The hawfinch," says Mr. Doubleday, "is not migratory, but remains with us during the whole of the year." This observer sufficiently accounts for the rarity of its appearance:—"Its shy and retiring habits leading it to choose the most secluded places in the thickest and more remote parts of woods and forests, and when disturbed it invariably perches on the tallest tree in the neighbourhood."

Grosbeak (*Coccothraustes vulgaris*).

C. chloris, the Greenfinch or Green Grosbeak; Grosbec Verdier of the French; *Loxia chloris* and *Fringilla chloris* of authors.

The male has the upper parts and breast yellowish-green; the head tinged with gray; the edges of the wings, outer webs of primary quills, with the basal part of the tail-feathers, yellow. Female with the upper parts greenish-brown; the breast grayish-brown; the wings and tail marked yellow, as in the male. Young similar to the female, with faint brown streaks on the back.

This bird is common in all the countries of Southern Europe, and is found generally in the cultivated parts of England, Ireland, and Scotland. It remains in this country all the year round, and frequents gardens, shrubberies, orchards, small woods, and cultivated lands. It feeds on grain, seeds, and insects. Its notes are harsh and inharmonious. The eggs are white tinged with blue, from four to six in number.

(Yarrell, *British Birds;* Macgillivray, *Manual of British Birds.*)

CO'CCULUS, a genus of Plants belonging to the natural order *Menispermaceæ*, consisting of climbers, whose leaves are usually more or less heart-shaped, and the flowers small, and either white or pale green, in loose panicles or racemes; in most cases they are diœcious, and are always very minute. The distinguishing characters of the genus are:—Six sepals in two whorls, a corolla of 6 petals, 3 or 6 distinct stamens, terminal 2-celled anthers opening vertically; 3, 6, or more ovaries; and 1-celled 1-seeded drupes. The species are usually powerful bitter febrifuges. *Cocculus crispus*, a twining plant found in Sumatra and the Moluccas, with a tubercled or warted stem, is employed by the Malays for the cure of intermittent fevers. Owing to its intense bitterness and twining habit it was called *Funis felleus* by Rumf. Another plant, the *Menispermum* *fenestratum* of Roxburgh, is in great repute among the Cingalese, who slice it, steep it in water, and swallow it along with the infusion as a stomachic.

C. villosus, a plant common in the hedges of Bengal, with variable downy leaves and axillary solitary female flowers, succeeded by deep purple berries the size of peas, is a species of considerable importance to the Hindoos. The juice of its ripe berries makes a good durable bluish-purple ink, according to Roxburgh, who adds some further particulars concerning its uses:—"A decoction of the fresh roots, with a few heads of long pepper, in goats' milk, is administered for rheumatic and old venereal pains; it is reckoned heating, laxative, and sudorific. The fresh leaves taste simply herbaceous; rubbed in water they thicken it into a green jelly, which is sweetened with sugar, and drank, when fresh made, to the quantity of half a pint twice a day, for the cure of heat of urine in gonorrhœa. If suffered to stand for a few minutes, the gelatinous or mucilaginous parts separate, contract, and float in the centre, leaving the water clear, like Madeira wine, and almost tasteless. Curry is made of the leaves, for people under a course of its roots, or jelly of the leaves."

The species most important to Europeans is that which produces the celebrated Calumba Root, *Cocculus palmatus*, from which a valuable bitter is procured. This plant is a native of Mozambique and Oibo, abounding in the thick forests that cover the shores of those countries, and extending inland for 15 or 20 miles. The Africans of these parts call it Kalumb. It has a large fleshy deep yellow root, divided into many irregular forks or fangs, which are amputated by the collectors, cut into slices, strung on cords, and hung to dry in the shade. The stem is covered with a thick whitish-green glandular fur: the leaves are large, rounded, heart-shaped, and deeply divided into from 5 to 7 sharp-pointed lobes. The plant is now cultivated in the island of Mauritius.

Cocculus palmatus.
a, male flower; *b*, under side, showing calyx; *c*, stamen; *d*, petal; *e*, bractea.

The name given to this genus is that of a kind of seed imported from the East Indies under the name of Cocculus Indicus Berries, which possess a powerful bitter poisonous principle, that, according to Goupil, exists principally in the kernel. The plant is found in the forests of Malabar, and when transplanted to the botanic garden, Calcutta, grew in a few years so as to extend over a large mango-tree, with a stout woody stem as thick as a man's wrist, covered with deeply cracked, spongy, ash-coloured bark. The leaves were very exactly cordate, entire, obtuse, or emarginate, of a hard texture, shining on the upper surface, and from 4 to 12 inches long, by from 3 to 8 inches broad. This plant is the *Menispermum Cocculus* of Linnæus, the *Cocculus suberosus* of De Candolle; but according to Messrs. Wight and Arnott, it does not properly belong to the latter genus, having the stamens combined into a central column and no corolla. They call it *Anamirta Cocculus*.

Dr. Christison recommends "the medical jurist to make himself well acquainted with the external characters of those berries, because, besides being occasionally used in medicine, they are a familiar poison for destroying fish, and have also been extensively used by brewers as a substitute for hops—an adulteration which is prohibited in Britain by severe statutes." This fruit is a berried drupe, varying in size from that of a pea to that of a laurel (or bay) berry; subglobose, emarginate, dark brown, opaque, rough, and wrinkled; the external integument, or husk, is very brittle; within is the seed or kernel, lunulate, oily, with a nauseous and intensely bitter taste. The kernel contains about one part in the hundred of Picrotoxia, or Menispermia, as some term it. Upon this principle its poisonous properties depend. It seems to act by exhausting the irritability of the heart, and if the dose be considerable its fatal effects are very speedily displayed. What renders it a more redoubtable agent is the circumstance of its leaving scarcely any trace of its presence on the coats of the stomach. *Cocculus Indicus* is never used internally in the practice of medicine, but an ointment formed of the powdered berries is very efficacious in some cutaneous diseases, such as *Porrigo Capitis* and *Sycosis Menti*. It speedily allays the inflammatory state; but its employment requires great care. Creasote will probably supersede it in such cases.

Calumba is the root of the *Cocculus palmatus*, a native of the forests of the east coast of Africa, whence it is sent to Ceylon, and thence to Europe. It occurs in the form of tranverse sections, the bark of which is thick and easily separable; the woody portion is spongy, of a yellow colour, and when old much perforated by worms. The odour is faintly aromatic, the taste bitter and slightly acrid. It contains much starch, a yellow azotised matter, a yellow bitter principle, traces of a volatile oil, woody fibre, salts (chiefly of lime and potassa), oxide of iron, and silex. The active principle is Calumbine, which may be obtained either by alcohol or ether. As Calumba contains nothing which can decompose the salts of iron it may be given along with them. The powder is a good form: the infusion soon spoils, but is otherwise a very excellent form; a tincture or extract retains the virtues, and keeps a long time.

Other roots are often fraudulently substituted for Calumba. Some of these are supplied by America, others by Africa. The American, which is the most common in England and the north of Europe, is the root of the *Frazera Waltera* (Mich.), a native of the marshes of Carolina. It may be distinguished from the true by its whiter colour, lighter texture, the presence of longitudinal pieces, and the taste being at first sweetish, and not nearly so bitter as genuine Calumba. Chemical tests further assist in discriminating them: solution of proto-sulphate or of permuriate of iron, does not trouble the tincture of the real, while it gives the false a dark green colour; the tincture of the genuine yields with tincture of galls a copious dirty gray precipitate, but the false none. The substance of the true is rendered blue by iodine, the false brown. In large doses the spurious causes vomiting, but the genuine allays that action.

Slices of bryony root are often employed to adulterate Calumba root.

COCCUS. [Coccidæ.]

COCCYZUS. [Cuculidæ.]

COCHINEAL is extremely rich in the finest red colouring-matter, and has been long employed in scarlet dyeing and in the manufacture of carmine. [Carmine, in Arts and Sc. Div.]

Cochineal has been analysed by Pelletier and Caventou, and they find that it contains:—1, a colouring-matter to which they have given the name of carmine, or carminium; 2, a peculiar animal matter; 3, fatty matter which is soluble in ether, and consisting of stearine, oleine, and an odorous acid; 4, phosphate of lime and of potash, chloride of potassium, and carbonate of lime, and potash combined with an organic acid.

Carminium was obtained by Pelletier and Caventou by digesting Cochineal in ether; treating the residue repeatedly with boiling alcohol, allowing it to cool; treating the deposit formed with pure alcohol, and then adding a volume equal to its own of pure sulphuric ether: a deposit of Carminium is thus formed.

The chief use of Cochineal is the dyeing of scarlet; the fine colour which it yields is converted to this tint by means of chloride of tin usually called Muriate of Tin, and by the dyer Tin Spirits.

The insect which constitutes Cochineal feeds chiefly upon the *Cactus cochinellifera* and *C. opuntia*. [Coccidæ.] The female insect only is collected. Several varieties are distinguished in commerce, and have different degrees of value attached to them, dependent chiefly upon the different methods employed to kill and dry the insects. When dried they resemble small grains scarcely so large as a pepper-corn, ovate, convex above, plane below, transversely furrowed, externally blackish-brown, but as if dusted with a white powder, light, friable, the internal substance consisting of extremely small grains, obscurely purple, but when reduced to powder of a rich purple. Inodorous, but with a bitter-sweet acrid taste. They impart to water or alcohol by digestion an intensely red colour. The colouring principle is termed Carmine. Adulterations are effected either by mixing old insects consisting of the mere skin or grains artificially prepared with the genuine.

Cochineal has hitherto been employed mostly as a colouring material either of tinctures or of other things, the nature of which it is wished to disguise; but lately it has been stated to possess diuretic and antispasmodic powers, aud to be useful iu pertussis, or hooping-cough. Its claim to this character requires yet to be established hy further evidence.

COCHLEA'RIA (from *Cochleare*, a spoon, the leaves of the species beiug hollowed out like the bowl of a spoon), a genus of Plants belonging to the natural order *Cruciferæ*, the sub-order *Pleurorhizeæ*, the tribe *Alyssineæ*. It has sessile ovate-globose or oblong silicles, with ventricose very couvex valves, with a promineut dorsal nerve; many seeds, not margined; the calyx equal at the base, spreading; the petals entire; the stamens toothless. The species are aunual or perennial herbs, usually smooth aud fleshy, but sometimes pubescent. The flowers are mostly white.

One of the most common species of this genus, as formerly defined, is the common Horse-Radish (*C. Armoracia*). This species however is now referred by some botanists to a new genus, *Armoracia*, and is described by Babington, iu his 'Manual of British Botany,' as *A. rusticana*. The genus *Armoracia* differs from *Cochlearia* in its globose pouches or silicles being destitute of a prominent dorsal nerve. The Horse-Radish, though described in hooks on British Botany, can scarcely be considered a native of Great Britain, as the wild specimens are evidently escapes from gardens.

C. officinalis, common Scurvy-Grass, has the radical leaves cordate, reniform, stalked; the stem-leaves sessile, oblong-sinuate, half embracing the stem; the pouch globose or ovate. It is a native of Great Britain, in muddy places near the sea-coast. This plant varies much in size, and two or three varieties have been described. The *C. Grœnlandica* of Smith aud Witheriug appears to be nothing more than a diminutive variety of this species. In France the Scurvy-Grass is called Cranson Officinal; in Germany Löffelkraut. When fresh it has a peculiar smell and a bitter acrid taste, which are quite lost by drying. The fresh plant is a stimulaut, and possesses the antiscorbutic virtues of the whole order. It has however a peculiar reputation in the disease called scurvy; hence its common name. It is sometimes used as a salad. When cultivated the seeds should be sown in July, iu drills eight inches apart, and when the plants are up they should be thinned to about six inches apart. Those plants which are taken out may be placed in new beds. They will all be fit for use in the following spring.

C. Danica has the leaves all stalked, the radical ones cordate, somewhat lobed; the stem-leaves 3-5-lobed, subdeltoid uppermost, mostly shortly stalked; the pouch roundish, elliptical. It is found in Great Britain, in a few places on the sea-coast. It is a more abundant native of the sea-coasts of the north of Europe, and is a native of Kamtchatka.

C. Anglica, English Scurvy-Grass, has the radical leaves stalked, ovate-oblong, entire; the stem-leaves oblong, entire or toothed, mostly sessile, the upper ones embracing the stem; the pouch oval, oblong veined. It is a uative of muddy sea-shores about the mouths of rivers, especially in Great Britain; hut is fouud in Norway and Lapland and other parts of Europe.

There are several other species of *Cochlearia* described; they are however most of them insignificant plauts, inhabitants of northern climates. For the culture and medical properties of *C. Armoracia* see HORSE-RADISH, in ARTS AND SC. DIV.

COCHLICELLA. [HELICIDÆ.]

COCHLICOSSA. [HELICIDÆ.]

COCHLIODUS, a genus of Placoid Fishes, from the Carboniferous Limestone of Armagh and Bristol. (Agassiz.)

COCHLITOMA. [HELICIDÆ.]

COCHLODESMA. [THRACIA.]

COCHLODINA. [HELICIDÆ.]

COCHLODONTA. [HELICIDÆ.]

COCHLOGENA. [HELICIDÆ.]

COCHLOHYDRA. [HELICIDÆ.]

COCHLOSPERMUM, a genus of Plants placed by Lindley in the natural order *Cistaceæ*, found in Asia, Africa, and South America. Botanists usually place it amongst the Theads (*Ternströmiaceæ*); but its parietal placentæ, acrisomerous flowers, and curved embryo lying in the midst of albumen, seem fatal objections to that association.

C. Gossypium is a large tree with downy shoots. Leaves 5-6 inches long, 5-lobed; ovary beneath on cylindrical downy stalks. Panicle terminal. Flowers large, and bright yellow. The trunk yields the gum Kuteera, which in the North-Western Provinces of India is substituted for Tragacanth.

C. insigne grows in Brazil on the plains in the western desert, part of the province of Minas Geraes, and also on the Caturges of Minas Novas. The leaves are coriaceous, palmate, 5-lobed, the lobes folded together coarsely and sharply double serrated, when full grown nearly smooth. A decoction of the roots is employed in internal pains, especially such as result from falls or accidents; it is also said to heal abscesses already commenced. *C. tinctorium* is used in cases of amenorrhœa, and also as a yellow dye.

(Lindley, *Flora Medica*; Lindley, *Vegetable Kingdom*.)

COCHLOSTYLA. [HELICIDÆ.]

COCK. [PHASIANUS.]

COCK OF THE WOOD. [CAPERCALI.]

COCKATOO. [PSITTACIDÆ.]

COCKATRICE, one of the names by which the Basilisk was known. "Many opinions," says Dr. Thomas Browne, in his 'Pseudodoxia Epidemica,' "are passant coucerning the basilisk, or little king of serpents, commonly called the Cockatrice; some affirming, others denying, most doubting, the relations made hereof. . . . . That such an animal there is, if we evade not the testimony of Scripture and human writers, we cannot safely deuy." This is very true; and it is equally true that the alleged generation of the Basilisk or Cockatrice, and the powers attributed to it in ancient times, were the most ridiculous fables.

Of Basilisks or Cockatrices there were said to be three, if not four kinds. Oue species burued up whatever they approached;—a sort of breathing upases, they made a desert wherever they went, for everything animal and vegetable withered before them; a secoud were a kind of wandering Medusa's heads, and their look, like Vathek's eye, caused an instaut horror, which was immediately followed by death *; the touch of a third caused the flesh to fall from the bones of the wretched auimal with which they came in contact; and a fourth, a concentratiou of evil, was said to be produced from the eggs of extremely old cocks (*Ova centonina*)), hatched under toads or serpents. There are authors who maintain that this parentage did not belong exclusively to oue kiud only, but that it was the origin of the whole infernal brood.

The Greek word Βασιλίσκος is often translated in Latin by the word *Regulus*. When mention is made of these Basilisks or Cockatrices in the Holy Scriptures, nothing appears to occur in the sacred volume beyond words expressive of a very poisonous and deleterious serpent, intended, in the opiuion of many commentators, to typify siu, misery, destruction, God's judgments, and the principle of evil, or Anti-Christ. Thus, in Psalm xci. 13, it is written—"Super aspidem et basiliscum ambulabis," which in the old quarto Bible, 'imprinted at London by Robert Barker, printer to the Kiug's most excellent Majestie, 1615,' is translated—"Thou shalt walke upon the lion and aspe;" and iu the more modern editions, "Thou shalt tread upon the lion and adder." In the 'Booke of Common Prayer,' by the same printer (Robert Barker), 1613, the passage stands, "Thou shalt goe upon the lion and adder," and so in the more modern editions. Again (Proverbs xxiii. 32), speaking of the abuse of the wine-cup, "Mordebit ut coluber et sicut Regulus venena diffundet," which in the old edition above alluded to is rendered, "Iu the end thereof, it will bite like a serpent aud hurt like a cockatrice;" and, in the modern version, "At the last it biteth like a serpeut and stingeth like an adder." So, Isaiah xiv. 29, "Ne læteris," &c. "de radice euim colubri egredietur Regulus," &c., in the old quarto, "Rejoyce not (thou whole Palestina) hecause the rod of him that did beate thee is broken; for out of y^e serpeuts roote shal come forth a cockatrice, and the fruit thereof shall be a fiery flying serpent:" and lix. 5, speaking of the wicked, "Ova aspidis rumpunt et telas aranearum texunt; qui comederit de ovis ejus morietur, et quod fractum erit erumpet in Regulum:" iu the old quarto, "They hatch cockatrice egges, aud weave the spiders webbe: he that eateth of their egges dieth, and that which is trod upon breaketh out into a serpent;" which the commentator thus explains, "Whatsoever commeth from them is poison and bringeth death. They are profitable to no purpose." The preseut editiou reads, "They hatch cockatrice-eggs, and weave the spider's-web: he that eateth of their eggs dieth, and that which is crushed breaketh out iuto a viper." Also Jeremiah viii. 17, "Ecce ego mittam vobis serpentes Regulos," &c., which the same old edition renders, "For behold I will send serpents aud cockatrices amoug you, which will uot bee charmed: and they shall sting you, saith the Lord;" which the commentator explains as follows: "God threateneth to send the Babylouians among them, who shall utterly destroy them in such sort as by uo meaues they shall escape." The modern edition scarcely varies from the old quarto, except in the substitution of the word 'bite' for 'stiug.'

These Basilisks were called Kiugs of Serpents, because all other dragons and snakes, behaviug like good subjects, and wisely not wishing either to be burnt up, or struck dead, or to have their flesh fall from their bones, although they were in full feast upon the most delicious prey, were supposed, the moment they heard the distant hiss of their king, to turn tail in a 'sauve qui peut' style, leaving the sole enjoyment of the bauquet to the royal monster.

Of the ancient profaue writers, Aristotle, as might be expected, says nothiug about the wonders of the Cockatrice; but Pliny, who dearly loved a fable, mentions the Basilisk more than once: thus ('Hist. Nat.' book viii. c. 21, and book xxix. c. 4) he enters at length into its deadly attributes, aud records the praises with which magicians celebrate the efficacy of its blood, which was considered an admirable antidote against sorcery (veneficia). Dioscorides, Galen, Solinus, Ælian, and others, are eloquent upon Basilisks, as are Avicenna, Grevinus, Scaliger, and many more.

Browne (*Pseudodoxia*) is of opinion that what "we vulgarly call a cockatrice, and wherein (but under a different name) we intend a formal identity and adequate conception with the basilisk, is not the basilisk of the aneients, whereof such wonders are delivered; for this

* Lady Anne, in Shakspere's play of Richard III., in answer to Richard's observation on her eyes, says—

"Would they were basilisks to strike thee dead!"

of ours is generally described with legs, wings, a serpentine and winding tail, and a crist or comb somewhat like a cock; but the basilisk of elder times was a proper kind of serpent, not above three palms long, as some account, and differenced from other serpents by advancing his head, and some white marks or coronary spots upon the crown, as all authentic writers have delivered." The following is Pliny's description ('Hist. Nat.' viii. 21). After stating that the Basilisk, like the beast Catoblepas, slays with its eye, he proceeds:—"The Cyrenaic province produces him of the greatness of not more than twelve fingers, and remarkable for a white spot, like a diadem, on his head. He drives away all serpents by his hissing, nor does he impel his body like the rest by a multiplied flexion, but advances lofty and upright (celsus et erectus in medio). He kills the shrubs, not only by contact, but by breathing on them, scorches up the green herb, and splits the rocks: such power of evil is there in him. It was formerly believed that if killed by a spear from on horseback, the power of the poison conducted through the weapon killed not only the rider, but the horse also." To this Lucan alludes in these lines.—

> "Quid prodest miseri basiliscus cuspide Mauri
> Transactus? velox currit per tela venenum,
> Invaditque manum."

Such a prodigy was not likely to be passed over in the legends of the saints. Accordingly we find that a good man (vir quidam justus) going to a fountain in the desert, suddenly beheld a Basilisk. He immediately raised his eyes to heaven, and with a pious appeal to the Deity, laid the monster dead at his feet. A somewhat similar miracle is related of the abbot St. John, who, by prayer, slew a Basilisk that lay hid in the bottom of a deep well, and reduced the monks of a monastery built by him to the greatest distress for want of water. Leo IV., by a similar piety, is said to have delivered Rome from a Basilisk whose breath afflicted the inhabitants with a terrible pestilence in his pontificate.

Jonston enumerates the attributes of the Basilisk in silence, till he comes to its alleged power of annihilating with the eye, when he sagely remarks, "Intuitu interimere vix crediderim, quis enim primus vidisset?"—"I would scarcely believe that it kills with its look, for who first could have seen it?" The worthy physician was not aware that those who went to hunt the Basilisk of this sort, took with them a mirror which reflected back the deadly glare upon its author, and, by a kind of poetical justice, slew the Basilisk with its own weapon.

It is curious to observe that Browne, who treats most of the fables about the Basilisk with contempt, is still unable to resist the story of its killing with the eye. We think we can trace a little of the sympathetic theory maintained by Sir Kenelm Digby and others, in the following passage: "According to the doctrine of the ancients, men still affirm that it killeth at a distance, that it poisoneth by the eye, and by priority of vision. Now that deleterious it may be at some distance, and destructive without corporal contaction, what uncertainty soever there be in the effect, there is no improbability in the relation. For if plagues or pestilential atoms have been conveyed in the air from different regions; if men at a distance have infected each other; if the shadows of some trees be noxious; if torpedoes deliver their opium at a distance, and stupify beyond themselves; we cannot reasonably deny that (besides our gross and restrained poisons, requiring contiguity unto their actions) there may proceed from subtiller seeds more agile emanations, which contemn those laws, and invade at a distance unexpected. That this venenation shooteth from the eye, and that this way a basilisk may empoison, although thus much be not agreed upon by authors, some imputing it unto the breath, others unto the bite, it is not a thing impossible; for eyes receive offensive impressions from their objects, and may have influences destructive to each other; for the visible species of things strike not our senses immaterially, but streaming in corporal raies, do carry with them the qualities of the object from whence they flow, and the medium through which they pass. Thus, through a green or red glass, all things we behold appear of the same colours; thus, sore eyes affect those which are sound, and themselves also by reflexion, as will happen to an inflamed eye that beholds itself long in a glass: thus is fascination made out; and thus also it is not impossible what is affirmed of this animal; the visible raies of their eyes carrying forth the subtillest portion of their poison, which, received by the eye of man or beast, infecteth first the brain, and is from thence communicated unto the heart."

But if the author of the 'Inquiries into Vulgar and Common Errors' here shows something of the lingering look with which most men regard received prejudices, he makes amends by declaring war against the story of the mode of the Cockatrice's production. "As for the generation," says he, "of the basilisk, that it proceedeth from a cock's egg hatched under a toad or serpent, it is a conceit as monstrous as the brood itself." Jonston, who appears to regard with a proper horror most of the nefarious proceedings of the Cockatrice, treats this part of the subject quite professionally. "Quomodo," remonstrates the sage doctor of medicine, "formari a gallo intra ovum possit cum utero destituatur non video." It is supposed that the idea took its rise from an Egyptian tradition concerning the ibis, "for an opinion it was of that nation that the Ibis feeding upon serpents, that venomous food so inquinates their ovall conceptions, or eggs within their bodies, that they sometimes came forth in serpentine shapes; and therefore they alwaies brake their eggs, nor would they endure the bird to sit upon them." (Browne.) Baptista Porta is of opinion that if a hen's-egg be placed in a ditch full of serpents, corruption (tabes), arsenic, and other poisons, it will produce an animal noxious to the sight and touch: at the same time he puts the experimentalist on his guard, lest in trying to produce this animal he might (like Frankenstein) give birth to a creature that would do him a mischief.

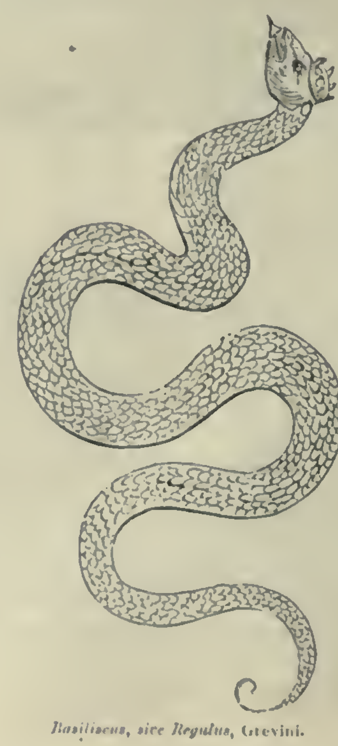
But what was to attack this terrible and unapproachable monster? There is an old saying that "everything hath its enemy;" and the Cockatrice quailed before the weasel. (Pliny, Solinus, and others.) The Basilisk might look daggers, the weasel cared not;—in he went to the scratch. When it came to biting, the affair became more serious; but the weasel retired for a moment to eat some rue (which, of course, was the only plant which the Basilisks could not wither, and was always growing where they lay), returned to the charge, and never left the enemy till he lay stretched dead before him. So that when men found out the den of a Basilisk, they had only to turn in a weasel, and the thing was done. The monster, too, as if conscious of the irregular way in which he entered the world, was supposed to have a great antipathy to a cock; and well he might; for as soon as he heard the cock crow, he expired. This we learn from Ælian; and African travellers, consequently, carried with them the 'bird of dawning' as a specific against Cockatrices.

The Basilisk was of some use after death. Thus we read that its carcass was suspended in the Temple of Apollo, and in private houses as a sovereign remedy against spiders'-webs, and that it was also hung up in the Temple of Diana, for which reason no swallow ever dared to enter the sacred place.

The reader will, we apprehend, by this time have "supped full" of absurdities, but still we can imagine his anxiety to know what a Cockatrice was like. We therefore subjoin from Aldrovandus, in whose work he will find two others made out of skates (Raia), a couple of figures, one of which he seems to owe to Cardan, and the other to Grevinus. In both it will be seen that

> "What seemed his head
> The likeness of a kingly crown had on."

Basiliscus in solitudine Africæ virens.



Basiliscus, sive Regulus, Grevini.

In these cuts will be seen an example of the 'Somnia Portentaque Thessala,' which have vanished before the light of science. [BASILISK.]

COCKCHAFER. [MELOLONTHIDÆ.]

COCKLES. [CARDIUM.]

COCKROACH. The common name for the *Blatta orientalis*. [BLATTIDÆ.]

COCKSCOMBS. [CELOSIA.]

COCKSFOOT-GRASS. [DACTYLIS.]

COCOA. [THEOBROMA.]

COCOA-NUT. [COCOS.]

COCOA-PLUM, the fruit of *Chrysobalanus Icaco*. [CHRYSOBALANUS.]

COCOON. [BOMBYCIDÆ; PUPA.]

COCOS, a genus of Plants belonging to the natural order of Palmæ. It is thus defined by Von Martius :—Both male and female flowers on the same spadix. Spathe simple; flowers sessile. Males: calyx 3-leaved; corolla of 3 petals; stamens 6; a rudiment of a pistil. Females: 3 sepals and 3 petals rolled together; ovary 3-celled; stigmas 3, sessile; drupe fibrous; putamen with three

Cocoa-Nut Palm (*Cocos nucifera*).

a, lower portion of the spathe opened; *b*, branchlet, with female flowers—the males on the upper end dropped off; *c*, female flower; *d*, stamens; *e*, female corolla; *f*, male corolla; *g*, germen.

pores at the base; albumen homogeneous, hollow; embryo next one of the pores at the base; stems either lofty or middle-sized, slender, ringed, or crowned by the bases of the petioles, with a pale fibrous wood; leaves pinnated; the pinnæ lanceolate or linear; flowers pale yellow; drupes brown, green, or orange-colour, rather dry. The genus contains several species.

Cocos nucifera, the common Cocoa-Nut Palm. This plant is found all over the tropical parts of the world, especially in the vicinity of the sea, growing within reach of salt-water, and establishing itself upon reefs and sandbanks as soon as they emerge from the ocean. Its principal range is said by Mr. Marshall to be between the equator and the 25th parallel of latitude, and in the equinoctial zone to an altitude of about 2900 feet. Its great importance to man has caused it to be cultivated wherever the climate is favourable to its growth; and accordingly it is sometimes found occupying extensive tracts to the exclusion of all other trees: the whole Brazilian coast from the river San Francisco to the bar of Mamanguape, a distance of 280 miles, is, with few breaks, thus occupied; and it was estimated that in the year 1813 no fewer than 10,000,000 trees were growing on the south-west coast of Ceylon.

The Cocoa-Nut Palm rises like a slender column to from 60 to 90 feet in height; its stem is of a soft fibrous nature, and is marked on the outside by rings produced by the fall of its leaves; two such leaves are said to drop off annually, and consequently the age of an individual is equal to half the number of the annular scars of its stem. About a dozen or fifteen leaves, each from 12 to 14 feet long, crown the summit of the stem; and as these are not inaptly compared to gigantic ostrich-feathers, they give the plant the air of an enormous tuft of vegetable plumes. A reticulated substance, resembling coarse cloth, envelops the base of each leaf-stalk, but falls off before the leaf is full grown. The flowers proceed from within a large pointed spathe, which always opens on the under side. In wet seasons the tree blossoms every five or six weeks, so that there are generally fresh flowers and ripe nuts on the tree at the same time: there are commonly from five to fifteen nuts in a bunch; and in good soils a tree may produce from eight to twelve bunches, or from 80 to 100 nuts annually.

In hot countries the uses to which the Cocoa-Nut Tree is applicable are innumerable. The roots are chewed in place of the areca-nut; gutters, drums, and the posts of huts are formed from the trunk; the young buds are a delicate vegetable; shade is furnished by the leaves when growing, and after separation from the tree their large size and hard texture render them invaluable as thatch for cottages; they are moreover manufactured into baskets, buckets, lanterns, articles of head-dress, and even books, upon which writing is traced with an iron stylus. Their ashes yield potash in abundance; their midrib forms oars; and brushes are formed by bruising the end of a leaf with a portion of the midrib adhering to it.

The sap of the tree during the time of blossoming ascends in large quantities: it is very sweet, and flows freely on the stem being punctured. In Ceylon it is daily collected by a class of people known as 'toddy-drawers,' who get up early to procure it for the use of the inhabitants. If allowed to stand, this toddy ferments, and forms palm-wine, from which an ardent spirit called arrack is distilled. By further distillation sugar is procured from this spirit, which is called 'gaggheng sugar.' This sugar, mixed with lime, forms a powerful cement, which resists moisture, endures great solar heat, and will take a fine polish. A farinaceous matter contained in the stem is a good substitute for sago. The ripe fruit is a wholesome food, and the milk it contains is a grateful cooling beverage; indeed, these together form the principal sustenance of the poor Indians in many countries. The nuts are inclosed in an outer husk, which has three flat sides terminating at the top in a blunt point. This peculiar form seems to be a special provision for the dissemination of the species; growing, as it does, near the shores of seas and rivers, its large seeds drop into the water, and their shape particularly adapts them for sailing; one edge, being downwards, forms the keel, while the upper surface, being flat, is acted upon by the wind, and so propelled along on the surface until it reaches some coral reef or shore, where, when stranded, it vegetates and rises to be a magnificent palm, affording food and shelter in abundance. The shell of the Cocoa-Nut is inclosed in a fibrous husk, which has now become a considerable article of commerce on account of the strength and durability of the fibre. Its preparation is very simple, consisting of little more than beating the husks to separate the fibres, which are dry and but loosely held together, and afterwards drawing them through a coarse comb or heckle, by which the refuse is cleaned out; it is then spun into yarns of different thickness, and is now extensively manufactured in Europe into ropes and matting: it is also used to stuff mattrasses and cushions. In India it is very generally used as cordage for vessels, and for fishing-nets; its lightness recommends it especially for the latter purpose. Its durability is surprising; perhaps no other vegetable-fibre will resist so long the action of alternate dryness and moisture. The hair-like fibre is made also into scrubbing-brushes; and the poorer classes in many places use the entire husk for the same purpose. The imports of cocoa-nut yarn and rope into England are greatly increasing: in the year 1851 (as nearly as can be ascertained) 10,661 tons were brought into Liverpool from Ceylon and Bombay. The oil of the Cocoa-Nut is valuable as an export: it is used largely in Europe for burning, in the manufacture of torches, and in the composition of pharmaceutical preparations. Mixed with dammer (the resin of *Shorea robusta*), it forms the substance used in India for paying the seams of boats and ships.

The name Cocoa seems to be a contraction of the Portuguese Macaco or Macaco, a 'monkey,' and to have been given from the resemblance between the end of the shell, where the three black scars are, and the face of a monkey. These three scars indicate the places through which the three embryos of the fruit, if equally and completely developed, would be protruded. But as out of the three ovules originally formed in the Cocoa-Nut two are constantly abortive, it happens that one only of the scars has to fulfil its destined purpose: that one is known by its being easily pierced by a pin; the others are as hard as the remainder of the shell. It is immediately below the soft scar that the embryo of the Cocoa-Nut is formed, and the use of the scar is to allow of a passage through the shell of the nut for the germinating embryo, which, without this wise contrivance, would be unable to pierce the hard case in which it is confined.

Cocoa-Nuts are brought to Europe as wedges to set fast the casks and other round packages in the cargo of vessels; their freight therefore costs nothing.

COCUMIGLIA, the name of a kind of Plum (*Prunus Cocumilia*) found wild in Calabria, and having the reputation of being a powerful febrifuge. It is described as bearing a general resemblance to the cultivated plum, but with short double peduncles, elliptical-obovate leaves, which are smooth, crenelled, and tapering to each end, the crenelling and the petioles covered with deciduous glands, and with ovate-oblong fruit of a dull tawny-yellow colour, with a slightly incurved point, and an austere astringent flavour. It is abundant about Sile, and on the mountains which overlook Monteleone, Staiti, Cotrone, and Mesoraca, on the sides exposed to the sea, as far as the height of about 3000 feet. The bark of this species is in extensive use for the cure of the intermittent fevers of Calabria, both in private practice and in the military hospitals, where it is preferred to cinchona. The bark of the root is principally employed either in decoction or extract; and its valuable qualities are attested by Savaresi, Polizzi, Tenore, and other Neapolitan physicians. The medicinal properties of the Cocumiglia are said to have been discovered by a noble citizen of Monteleone, who annually caused a considerable quantity of the extract to be prepared and distributed among the Calabrian peasantry. It is worthy of notice that febrifugal properties are assigned by Mérat to the bark of the common sloe; and, considering the very close affinity between the Cocumiglia, the sloe, the bullace, and the common cultivated plum, it is highly probable that similar qualities are possessed by all of them. The bark should be collected in the months of November, December, or January.

CODDY MODDY, a Gull in its first year's plumage. (Montagu.) [LARIDÆ.]

CODEIA, an alkali existing in Opium. [PAPAVER.]

COD-FISH. [GADIDÆ.]

CODIUM, or *Sea-Purse.* [ALGÆ.]

CŒLACA'NTHUS, a genus of Fossil Fishes, which occurs in the Coal Formation and the Magnesian Limestone of the north of England. (Agassiz.)

CŒLEBOGYNE, a genus of Plants belonging to the natural order *Euphorbiaceæ*. This genus was named by Mr. J. Smith from a specimen grown in the Royal Gardens at Kew. It is remarkable for the fact that being diœcious, the pistiliferous flowers have ripened their fruit and produced seeds containing a perfect embryo without the presence of the staminiferous plants. This appears to be quite an exceptional case to the law of production of the embryo by the agency of the pollen-cells coming in contact with the ovule. Further observation may detect some hitherto undiscovered means by which the pollen-cells of perhaps an allied plant may come in contact with the pistils of the *Cœlebogyne.* (*Linnæan Transactions.*)

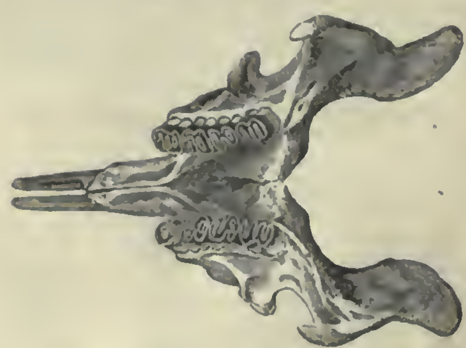
CŒLO'GENYS (Illiger), a genus of Rodent Animals belonging to the division without clavicles. Its place with the older naturalists was either among the Rats (*Mus*) or among the Hares. Linnæus, in his last edition (the 12th), arranges it under his extensive genus *Mus*, with the denomination of *Mus Paca*, and quotes, among others, Ray, who termed it *Mus Brasiliensis*. Waterhouse places it with *Dasyprocta* in the sub-family *Dasyproctina*.

The genus *Cœlogenys* possesses two strong incisor teeth in each jaw, the upper ones flattened in front and truncated obliquely, chisel-like; the lower slightly compressed laterally, and rounded on the anterior face. But these incisors, though of some strength, are small when compared to those of the porcupines and of the beaver. Like all the true Rodents, *Cœlogenys* has no canines, and a void space or bar separates the incisors from the molars, which amount to 8 in each jaw, and are not unlike those of the Agouti, that is to say, they are composed of complicated riband-like plates of enamel set in the interior bony cement, which vary and become more or less visible according to the greater or less attrition which the crowns have undergone. But, in *Cœlogenys*, besides the difference in the complications, the molars augment in size from the first to the last, which is one-third larger than the tooth that precedes it. (F. Cuvier.) There is also a striking peculiarity in the great development and projection of the zygomatic arches, which are enormously large, giving great breadth to the face, and descending unusually low. These were remarked by Daubenton; and Buffon observed that, on each side and towards the lower part of the upper jaw, there existed a sort of longitudinal fold, destitute of hair in the middle, so that, at first sight, it might be mistaken for the mouth of the animal. This fold, which Buffon does not seem to have investigated, is the opening of a shut sac of some extent, extending upwards behind the arch formed by the cheek and temporal bones, whose inner surface, as far as the sac extends within them, is lined by a continuation of the integument of the face, and, in addition to it, the animal is furnished with true cheek-pouches in their usual situation. These last are capable of being greatly dilated, and when filled, they are said to occupy the whole space beneath the zygomatic arches.

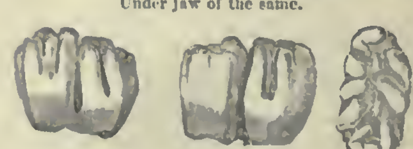
Dental formula:—Incisors, $\frac{2}{2}$; molars, $\frac{8}{8} = 20$.

Skull of *Cœlogenys.*

Upper Jaw of the same.



Under Jaw of the same.



Germ of the first molar, enlarged. View of the outside, inside, and crown. F. Cuvier.

F. Cuvier observes, that the Pacas are, among the Omnivorous Rodents, what the Capybaras are among the Herbivorous section. The first possess molars with roots distinct from their crowns, to the number of 4 on each side of either jaw. Those of the upper jaw are nearly of a size; but, in the lower, they diminish gradually from the last to the first. All the molars, before they have been subjected to the process of mastication, present, on the upper surface of the crown, 4 tubercles, which more or less completely divide the tooth broadwise, and are separated by three transverse furrows, more or less large or deep. When the crown of the tooth is exposed to mastication, the top of the tubercles begins to wear away, and the enamel, instead of forming a sort of hood or cap, presents a series of riband-like foldings, the outlines of which are conformable to the tubercles and furrows. In proportion to the continuance of the abrasion, the tubercles are successively effaced; and, finally, nothing is to be seen but the enamel, which hoops the tooth externally, and that which penetrates the interior and is there complicated, the plaits going very deep, so that the ribands of enamel, whose edges are exposed on the triturating surface, change their appearance with the age of the animal, and terminate by disappearing in a great measure.

The Pacas approach the Capybaras and the Agoutis most nearly, and are closely allied to the latter by their general form and the similarity of their organisation. The dental and generative systems in both are very nearly alike; neither have clavicles, nor indeed has the Capybara; and though the Agouti has only three toes on the hind feet, the two additional hind toes of the Paca are hardly more than rudiments. The great differences consist in the zygomatic development, the folding back of the skin under the zygomatic arch—and the consequent bluff appearance of the head—the cheek-pouches, and the fur.

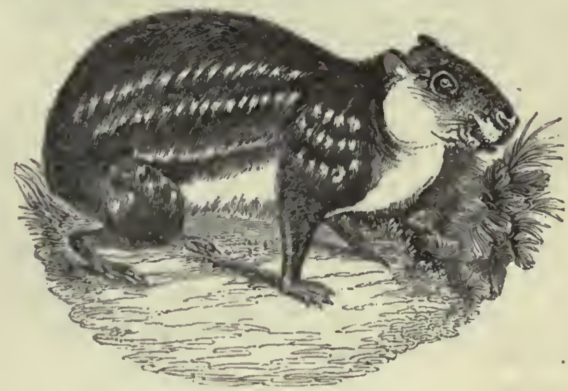
F. Cuvier records two species, *C. subniger* and *C. fulvus*; but Baron Cuvier, in the last edition of the 'Règne Animal,' treats them as varieties of the same species.

C. Paca (Rengger), the Paca. It is the *Mus Paca*, Linnæus; *Cavia Paca*, Schreber; *C. subniger*, F. Cuvier; *C. niger*, F. Cuvier; *Osteossera platycephala*, Harlan; Le Pag, D'Azara.

Its general appearance reminds the observer of the Pachydermatous animals, for it is thick-set and stubby. The legs are thick, the neck short, the head heavy, the body rounded, the gait clumsy, but the motions of the animal are prompt and sudden. All the feet have five toes, which anteriorly have the ordinary proportions, but posteriorly the analogues of the little toe and great toe are extremely short in proportion to the rest, and almost rudimentary, like the upper or lateral toes in the hog. The claws are conical, thick, and strong, and proper for digging. The tail is reduced to a naked immoveable tubercle, a few lines in length. The principal male organ is directed backwards, and there is no external appearance of the testicles. The external ear is moderate in size, rounded, and simple. There is nothing particular about the eye, the pupil of which is round. The nostrils, which are large and almost united, open transversely at the muzzle. The tongue is very soft, short, and thick. The upper lip is divided, the interior of the mouth is furnished with cheek-pouches, and, externally, the large area formed by the development of the zygomatic arch is lined on its inner surface with a continuation of the skin of the cheeks, which is reflected from the face, so as to form a hollow pouch, of which there is no other example among mammiferous animals, and the use of which it is difficult to divine, if the great development of the zygomatic arch be not destined to preserve the true cheek-pouches (abajoues) from external shocks. Strong whiskers spring from the sides of the muzzle, and from behind the eye. The fur is composed of silky hairs, very short, very thin, and very stiff, of a blackish-brown on all the upper parts of the body, excepting four rows of parallel spots, which begin at the shoulders and terminate at the buttocks: the spots of each row are so approximated, that when viewed in a particular direction they seem to form an uninterrupted line, and the row nearest the belly is almost confounded with the colour of that part, which is white, as well as the under parts of the lower jaws, the internal surface of the limbs, and the claws. Length of the body, from the occiput to the insertion of the tail, 16 inches: length of the head, from the occiput to the end of the muzzle, 5 inches. Height, to the shoulders 12 inches—to the top of the buttocks (train de derrière) 14 inches, French. (F. Cuvier.)

This animal is better known as the Paca of zoologists generally, and, after the Capybara and Coypu, is one of the largest of the South American Rodents. It is the Spotted Cavy of Pennant and Bewick, the Pag of the Brazilians, Paig of the inhabitants of Paraguay, Ourana of some of the tribes of Guyana and Pakiri of others, the Pak of the colonists of Cayenne, and the Water-Hare of those of Surinam. In all these countries it is common, with the exception of Paraguay, where, according to D'Azara, it is very rare. They formerly existed in the islands of the West Indies.

In a state of nature the habitation of the Paca is in low humid forests, and in the neighbourhood of water. The animal digs a burrow like the rabbit, but much less deep; indeed it is so near the surface, that the foot of the pedestrian often breaks through, and, sinking into the tunnel, drives out the tenant. There are generally three issues to a burrow, and the aperture of these the animal covers with dry leaves and branches. To take it alive, the hunter stops two of these apertures, and digs into the third; but when the penetralia are reached, the hapless besieged makes a most determined resistance, fighting the enemy with ferocity, and trying to bite. When undisturbed, it often sits up and washes its head and whiskers with its two fore paws, which it licks and moistens with its saliva at each ablution, like a cat; and with these fore paws, as well as with the hind ones, it often scratches itself and dresses its fur. Though heavy and corpulent, it can run with a good deal of activity, and often takes lively jumps. It swims and dives with great adroitness, and its cry resembles the grunting of a young pig. Its food consists of fruits and tender plants, which it seeks in the night, hardly ever quitting its burrow in the day, the strong light of which, as is the case with other nocturnal animals, is oppressive to its eye. The planter often rues the visits made by these midnight foragers to his sugar-canes. The female is said to bring forth at the rainy season, and to produce but a single young one, which stays a long time with the mother. The Pacas are very cleanly creatures, never dropping their excrements near their dwellings, but going to a considerable distance for that purpose.



The Paca (*Cœlogenys Paca*).

In captivity, according to F. Cuvier, no animal can exhibit less intelligence. When offended, it throws itself violently at the object which has displeased it, and then makes a grumbling, which breaks out into a kind of barking; and when it is not eating it is sleeping. But it requires a soft and well-made bed; and, to obtain this, it collects with its mouth hay, herbage, straw, anything indeed that suits its purpose, of which it makes a little heap, and then lies down in the centre of it. This bed it never defiles, but goes to the extremity of its cage the farthest removed from it, and constantly resorts to the same spot for the same purpose. If, says F. Cuvier, it is but little favoured on the side of intelligence, it appears on the other hand to be recompensed by a large share of instinct, to judge, at least, by appearances. Mr. Bennett, from his observation of one which lived for some months in the Garden of the Zoological Society in the Regent's Park, says that it is quiet and contented in captivity. Buffon, who kept one for some time in his house, found it familiar and mild.

The flesh is stated to be excellent and of good flavour; but as it is very fat and rich, it soon cloys: it is prepared for cookery by being scalded like a sucking pig. Piso gives the following character of its merits for the table:—"Carne est tenera, pingui lardo non indigens, si assetur, sed inter epulas magnatum, sicut lepores et capreæ in Europâ, habetur." Its skin is of no value to the furrier; but its thickness might make it available in the useful arts. F. Cuvier thinks that it would be possible to introduce this animal into our European rural establishments, and that it would form a very good acquisition in the department of domestic economy.

C. laticeps (Lund) is a fossil species founded upon a cranium from the caverns of Brazil. In this species the surface of the frontal bone and zygomatic arch are smooth. It also differs from the last species in the infra-orbital opening being larger, the upper part of the bony ring which incloses it narrower, and the zygoma is thrown more boldly forwards. Dr. Lund distinguishes a second species from the same caverns, which he calls *C. major*. It is much larger than the last. Mr. Waterhouse says, "From the caverns above alluded to the British Museum contains numerous remains referrible to the genus *Cœlogenys*. The most characteristic specimen among these is a considerable portion of a skull, in which I can find no points which would lead me to suppose it belonged to a species distinct from the common Paca."

CŒLOPTY'CHIUM, a genus of *Spongiadæ*, proposed by Goldfuss, for some fossils of the Chalk.

CŒNURUS. [ENTOZOA.]

CŒREBA. [NECTARINIDÆ.]

COFFE'A, a Cinchonaceous genus, consisting of many species of tropical berry-bearing shrubs, one of which, *Coffea Arabica*, is celebrated for the agreeable stimulating effect of an infusion of its roasted albumen. This substance, the coffee of commerce, is to that plant what the flour is to corn, the white meat to a cocoa-nut, and the aromatic ruminated substance to a nutmeg. It is a secretion formed in the interior of the seed, and enveloping the embryo plant, for whose support it is destined when it first begins to germinate; it constitutes the principal part of the seed, the embryo itself being a minute body lying in a cavity at one end of the albumen. Unskilful observers are often unable to find the embryo; but it may readily be seen by the following simple means:—Take a new sample of small fine unroasted Mocha coffee, and throw it into boiling water; the embryo will, after a little while, be expelled with force from the albumen in a majority of cases.

The genus *Coffea* is known among Cinchonaceous Plants by having a tubular corolla, with four or five spreading divisions; stamens arising from the naked throat of the corolla, and either extending beyond it or inclosed within it; and a succulent berry containing two cells lined with a cartilaginous membrane, of the texture of parchment, in each of which cells there is a single seed, convex at the back and deeply furrowed in front, in consequence of the albumen being rolled inwards.

Coffea Arabica is an ever-green shrub, with oval shining wavy sharp-pointed leaves, white fragrant five-cleft clustered corollas with projecting anthers, and oblong pulpy berries, which are at first of a bright red, but afterwards become purple. It is stated by Niebuhr to have been brought from Abyssinia to Yemen by the Arabs from a country similar to their own plains and mountains. By that people it has for ages been cultivated in the hilly range of Jabal, in a healthy temperate climate, watered by frequent rains, and abounding in wells and water-tanks. Here the plants are grown in grounds that are continually irrigated, and in soil from one to one and a half foot deep. Among the plantations are interspersed various kinds of trees, whose shade has a beneficial effect upon the coffee-bushes. When in flower, they diffuse a most delicious fragrance, in the midst of which the natives fix their habitations. The fruit begins to ripen in February; and when the seeds are prepared, they are conveyed to the city of Beit el Fakih, whence part goes to Mocha, and another portion to Hodeida and Loheia, whence it finds its way to Djedda and Suez for the Turkish and European markets.

Coffee Plant (*Coffea Arabica*).

a, Corolla opened, showing the stamens; *b*, pistil; *c*, berry; *d*, *e*, sections of the same; *f*, embryo.

Richness of soil in the West Indies has been thought to be the cause of the inferior quality of coffee grown in that part of the world, and to the supposed dryness of Yemen has been ascribed the excellence of Mocha coffee. But it has been shown that the Arabs counteract the effect of any dryness in the air by abundant irrigation; and that moreover it is not in the Tehama or dry parts of the country that it is cultivated, but on hill-sides, where the temperature is much lower, and where it rains daily for four months in the year.

The seed of *Coffea Arabica* consists of much horny albumen, and a peculiar principle or alkaloid, termed Cafeine, which contains more nitrogen than any other known vegetable substance. The seed is used in a raw state in medicine, and, when roasted, both as a medicine and still more extensively as an article of diet. The coffee-plant begins to produce fruit when two or two and a half years old; but the quality of the seeds from young stems is not so good as that from stems four or five years old. The size and colour of the bean (as the inner part of the seed is called) vary considerably, those from the West Indies being larger than those from the East. Much more depends upon the manner of roasting and making the coffee, than upon the quality of the bean. The superiority of French coffee, in the preparation of which little or no Mocha coffee is used, proves this position. Beans of a good quality are hard and heavy, sink quickly in water, are of a light yellowish-green colour, not discoloured or black, and possess the odour of coffee, which though faint is peculiar, and are free from any damp smell. Beans recently collected, or only two or three months from the tree, are not so good as those about a year old; when older than this they become deteriorated. From the analysis of Seguin and Schrader, coffee consists of coffee-bitter (impure cafeine), solid fat, resin, a little aromatic principle, gum, albumen (this albumen, according to Seguin, unites with the yellow coffee-bitter, and forms a green), and lignin.

The taste of raw coffee is somewhat sweetish; but the application of heat in the process of roasting produces important changes. The bean increases to nearly twice the original size, while it loses about one third of its weight: a powerful and agreeable odour is evolved, and a large quantity of empyreumatic oil, which appears in small drops on the surface, is formed along with a bitter principle, probably by an alteration in the cafeine, and of the saccharine matter. The roasting should take place in a close revolving iron cylinder, over a clear but moderate fire, and should not be carried too far: when the beans have acquired a light chestnut colour, the roasting should be discontinued. The beans are then to be cooled quickly by being tossed up into the air, and the grinding, or rather rough pounding, should be performed in a covered mortar or mill. The drink should be prepared from it as soon as possible, by infusion, which is preferable, unless some apparatus be employed by which a kind of decoction is made in a close vessel. About half an ounce of coffee powder should be used for every eight ounces (half a pint) of water. In Britain the roasting is generally carried too far; and the subsequent parts of the process, instead of being performed immediately, are often postponed for days or even weeks, by which the aroma is dissipated: when made the liquid is generally deficient in strength and clearness. The employment of white of egg or fish-skin for clarification is decidedly objectionable: clearness is thus purchased, but at the expense of the strength.

The addition of milk (which should always be hot) and of sugar heightens the nourishing qualities of this beverage, and in the morning renders it a more substantial article for breakfast. When taken after dinner to promote digestion it should be without milk, and, where the palate can be reconciled to it, without sugar.

There is much uncertainty as to the first introduction of coffee into the western parts of Europe. The Venetians, who traded with the Levant, were probably the first to use it. We find it mentioned in the year 1615 by Peter de la Valle, and thirty years after this some gentlemen returning from Constantinople to Marseille brought with them a supply of this luxury, together with the vessels required for its preparation.

Coffee was first introduced into England in the year 1652, fourteen years earlier than the introduction of tea. The first coffee-house was opened in George Yard, Lombard Street, by a Greek named Pasque, who was brought from Turkey by a merchant of the name of Edwards.

The adulterations of ground coffee are very considerable; the most important of these is chicory, a dark brown powder made from the roasted roots of the *Chicorium Intybus*. It is perfectly harmless, and by some is thought to be an agreeable addition to the coffee: it is not however of so much value, and should not therefore be added to the coffee by the dealer, but sold separately, so that those who desire to add it may purchase it themselves. Various other seeds are used either as imitations or adulterations of coffee, such as Rye-Chick Peas (*Cicer arietinum*), Broom Seeds (*Spartum scoparium*), the Yellow Water-Iris (*Iris pseudacorus*), and the Dandelion root (*Leontodon taraxacum*). It has been suggested to use the leaves of the coffee-plant in infusion the same as those of the tea-plant, and it is said they form a very agreeable beverage; but the berries are too valuable in themselves to permit the trees being injured by the loss of their leaves, as they would be were there any demand for them as an article of diet.

For medical uses, trade, and cultivation, see COFFEE, in ARTS AND SC. DIV.

COIX, a genus of Plants belonging to the natural order of Grasses. One of the species, *C. Lachryma*, has hard stony fruits, which are known by the name of Job's Tears. These fruits are supposed by some writers to be strengthening and diuretic.

COLAPTES. [PICIDÆ.]

COLARIS. [CORACES.]

COLCHICACEÆ. [MELANTHACEÆ.]

COLCHICUM, a genus of Plants belonging to the natural order *Melanthaceæ.* It has a coloured funnel-shaped perianth, with a very long subterranean slender tube, and a somewhat campanulate 6-parted limb; 6 stamens inserted into the throat of the tube; a 3-celled ovary; numerous ovules in 2 or 4 rows; 3 long filiform styles; stigmas somewhat clavate; capsule 3-celled, 3-partible, opening inwardly; seeds numerous, roundish, with a shrivelled skin.

C. autumnale, Meadow Saffron, is a plant with a solid bulb-like rootstock, found wild in various parts of Europe, as well as in Great Britain, and forming a gay carpet in the autumn in the fields, where its lively purple crocus-like flowers spring up. Its under-ground stems, or bulbs, as they are called, and its seeds, abound in an acrid stimulating deleterious principle, which has been carefully examined by modern chemists, and the plant forms an important article in the Materia Medica, large quantities of both rootstocks and seeds being annually consumed in the manufacture of Eau Médicinale, and other medicinal preparations. The rootstock is irregularly egg-shaped, and covered with a dry brittle brown skin; at its base it bears a bud, which feeds upon the parent stock, exhausting and finally replacing it every year. Its flowers are large, pale purple, and spring up in the autumn without leaves, forcing themselves readily through the soil, and expanding just their orifice, together with the anthers and stigmas, above the surface of the soil, while the tubular part with the ovary and filaments, remains enveloped in membranous sheathing spathes below the soil. Each stock produces six or eight of these flowers. The stamens are six, the ovaries three, each with a long thread-shaped style, and not adhering in any degree to the tube of the flower. These are succeeded by three little follicles, which slightly adhere to one another by their inner edge, and in the spring are elevated above the soil by their lengthened footstalk. At this time, too, the foliage makes its appearance in the form of an erect tuft of broad, oblong, shining, sheathing leaves. Each follicle contains several oblong seeds. It is found in the moist rich pastures of England, and in various other countries of Europe.

Colchicum is so very like an autumn crocus that an inexperienced observer might readily mistake the one for the other. They are however to be distinguished by the crocus having only three stamens, one style, and an inferior ovary, while the Colchicum has six stamens, three styles, and a superior ovary—distinctions of no little importance when the poisonous qualities of Colchicum, in which the crocus does not at all participate, are considered.

For medicinal purposes the rootstocks of Colchicum should be collected at Midsummer, and they should be used immediately; for at that time the peculiar principles which they contain are in the greatest state of concentration. If they are employed at a time when the plant is in a state of growth, especially when it is coming into flower, those principles are partly lost and decomposed by the growth of the plant, and there is no certainty as to the quantity of Colchicia that a given weight of the rootstocks will yield.

Other species of Colchicum are cultivated for the sake of their flowers, but they are of no medicinal importance, and are very badly distinguished from each other by botanists.

Three different parts of *C. autumnale* yield an active principle used in medicine, but they respectively contain it in the greatest intensity at different seasons of the year; the cormus (incorrectly called root or solid bulb) having it in perfection about June or July, the flowers in September, and the seeds the following spring. The cormus and seeds are most frequently employed in Britain; but should the proper period (Midsummer) for collecting the cormi be neglected, the flowers may be substituted, though they can only be put to immediate use, as they do not keep well. The cormi are found at various depths under ground; when very deep they are not so good, being the produce of old exhausted plants. Each cormus is about the size of a hazel-nut or walnut, ovate or heart-shaped, consisting of a white fleshy succulent substance, which, when cut across, exhibits roundish plates. It is somewhat flatter on one side, on which also may be discovered a groove, in which is lodged the germ of the flower-stem of the following year. The recent cormus has a nauseous radish-like odour; when dried, no odour; the taste is sweetish-bitter, leaving an acrid sensation in the throat.

The seeds, which should be collected in May, are small, globose, about the size of a grain of millet, of an obscure fawn-colour, opaque, rough, and wrinkled, with a white hilum at the base, very hard, tough, and difficult to reduce to powder. The relative proportions of the constituent ingredients of the cormus differ greatly, according to the season of the year when it is taken up for examination, as Stolze's analyses demonstrate. The active principle of Colchicum was long considered to be the same as that of Veratrum, and hence called Veratria; but Geiger and Hesse have shown that it is different, and have termed it Colchicia. The seeds contain this principle, and likewise some thick oil. Colchicum imparts its active principle partially to water, but more so to acetic acid, proof spirit, and wine. A sirup is sometimes formed of it, but it does not keep well.

COLE, COLESEED. [BRASSICA.]

COLEOPTERA (κολεόπτερα), a name first applied by Aristotle ('Hist. Anim.' i. &c.), and now universally adopted, to designate one of the orders into which Insects are divided, the species of which order are commonly known by the name of Beetles.

Nearly all true Insects, or those Annulose Animals which have six legs, exhibit, in a more or less developed state, four wings, or members, which, although they may not enable the animal to fly, occupy the same situation, and are analogous to those which in many insects are true organs of flight.

These members are modified in various ways to suit the habits of the species or of the groups in general; but in those insects whose habits are of a nature not to require the power of flight they are very seldom entirely wanting, being found either in a rudimentary state, or modified in their structure so as to perform some other office. In those instances where the wings are only rudimentary, we cannot often assign any positive use for them; we can only perceive that the affinities of the individuals exercise an influence in these respects—that is to say, those species which belong to groups where the individuals generally possess perfect wings, will often possess these members in a rudimentary state, when from their habits they do not require the power of flying. It appeared necessary to make these few general remarks before proceeding to give the distinguishing characters of a Coleopterous Insect, in order that the nature of these characters and the departures from them might be understood; for it is difficult to give a strict definition of any group of animals.

The insects, then, which constitute the order *Coleoptera* may be characterised as having four wings, of which the two superior are not suited to flight, but form a covering and protection to the two inferior, and are of a hard and horny or parchment-like nature, and when closed, their inner margins, which are straight, touch and form a longitudinal suture (*fig.* 16, *c*); the inferior wings, when not in use, are folded transversely under the superior, and are membranous. From this character of having the wings in a sheath, the term *Coleoptera* was applied, it being composed of the two Greek words *κολεός*, a sheath, and *πτερά*, wings. The superior wings, which form the sheath, are generally called elytra.

The principal exceptions to this general rule are as follows:—those beetles which have no under-wings, or have them in a rudimentary state, as in *Carabus cancellatus*, and those in which the elytra are soldered together at the suture, in which case we believe no under wings are ever found. Another species of *Carabus* (*C. violaceus*) and many among the *Heteromera* afford examples of this exception. There are several beetles in which the elytra do not close at the suture, and in which the under-wings are not protected by them. Such is the case in the genera *Sitaris*, *Ripiphorus*, and others, in which the wing-cases, or elytra, are somewhat pointed; and in the genus *Molorchus*, among the *Cerambycidæ*, the wing-cases are very short, and the wings are not folded beneath them when at rest. In the *Staphylinidæ* the wing-cases are also very short, but the under-wings, by a series of folds, are, when not in use, entirely concealed beneath them; and as in this tribe the elytra form a straight suture when closed, the only exception consists in the greater number of folds in the under-wings.

Numerous other exceptions might be noticed, but we shall merely mention the genus *Meloe*, where one elytron partly folds over the other; the families *Lampyridæ* and *Telephoridæ*, in which the elytra are comparatively soft and flexible; and the glow-worm, the female of which beetle has neither elytra nor wings.

The larvæ of Coleopterous Insects are generally composed of thirteen distinct segments, the head included. They are almost always of an elongate cylindrical or slightly depressed form; the body is often soft and fleshy, and of a white colour: in these the head is always of a firmer texture, being of a horny nature. The principal parts of the mouth are the same, as to number, as in the perfect insect, although the parts are (as far as our observations go) always differently formed. The head is furnished with two antennæ, which are generally minute, and composed of four joints; and ocelli, or simple eyes, are, on each side, situated near the base of the antenna. The body is furnished with six legs, which are attached to the first three segments, or those next the head, a pair to each: the legs are small and usually terminated by a simple claw. Sometimes, in addition to the ordinary legs, the larva is furnished with false legs (often termed pro-legs); these are fleshy tubercles which the animal can protrude at pleasure, and are used to propel the body. Some larvæ have only two of these pro-legs, which are attached to the apex of the terminal segment of the abdomen, or placed beneath that segment; and in the larvæ of the species of *Cerambycidæ* each segment of the body is thickened in the middle both above and below: these parts the animal has the power of protruding considerably, by which means it is enabled to thrust itself forwards or backwards in the holes in the trunks or boughs of trees which are formed by its feeding upon the wood.

The larvæ of groups (generally believed to be natural) very closely resemble each other, though those of different groups are sufficiently distinct; hence a knowledge of the larvæ is of great use in determining the natural affinities of species when their families or sections are not well ascertained.

We select as an illustration of the principal characters of a Coleopterous larva, that of one of the *Lamellicornes*, a group which comprises the common Cockchafer, and where the larvæ generally, if not always, have their body bent under at the apex.

Fig. 1, Larva of a Coleopterous Insect; *a*, natural size; *b*, leg; *c*, antenna; *d*, mandible; *e*, maxilla. Fig. 2, Pupa state of the same insect. Fig. 3, natural length of the pupa.

We shall now proceed to the pupa state of Coleopterous Insects. Those larvæ that live in the ground generally prepare for the pupa state by removing the soil which surrounds them so as to form an open oval space: others form a species of cocoon around them, constructed of particles of earth, and other substances within reach, joined together by a kind of web or glutinous substance. Wood-feeding larvæ, or those that live in the trunks or bark of trees, for the most part assume the pupa state without such preparation.

Some larvæ which feed upon plants inclose themselves in a spherical cocoon; others again suspend themselves by the tail, and hang from a leaf or stalk of the plant. In one instance we have known the animal to assume the pupa state within the skin of the larva. The pupæ of Coleopterous Insects are what is termed incomplete, that is, all the parts of the perfect insect are distinctly visible, the legs, antennæ, wings, &c., being each inclosed in a separate sheath, and not as in the pupa or chrysalis state of moths and butterflies, where all the parts are soldered together, or as in the pupæ of the *Hemiptera* (bug-tribe), or *Orthoptera* (locust-tribe), in which stage the insect is active, and in some instances cannot be distinguished from the perfect insect. This character of incompleteness in the pupa is therefore one of great importance, and is generally added to the definition of a Coleopterous Insect, for there are no other insects which, in the pupa state, are incomplete, and which in the imago state could be confounded with the *Coleoptera*.

Having traced the beetle through the larva and pupa states, we arrive at the last or imago state, the perfect insect.

Beetles belong to the *Mandibulata*, which forms the first of the two great sections into which Insects are divided: a section, the individuals of which are distinguished by their possessing distinct mandibles; and as the Insects of the order *Coleoptera* possess the mandibles and all other parts of the mouth so well developed, they have by many been placed at the head of the Insect-Tribe. We imagine, however, that the reasons stated for so doing are not sufficient.

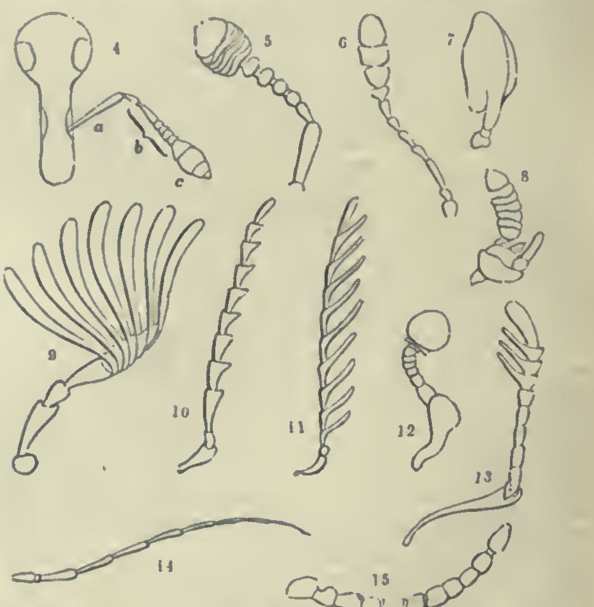
The anatomy of Insects is given under the article INSECTA. We shall therefore at present confine ourselves to the external parts of a beetle, and to those only which it is essential to know, in order to understand the description of those insects.

When we look at a beetle, we perceive that it is composed of three distinct parts, the foremost of which is the head; the next is called the thorax; and the last the abdomen.

The head is furnished with two eyes, two antennæ, and the various parts of the mouth, called the trophi. The eyes are situated on each side of the head, and are generally prominent, and always convex masses composed of an immense number of lenses arranged closely together, so that their interstices form hexagons. These are technically termed compound eyes, and are of a circular or oval form, frequently kidney-shaped, and in some instances (as in the genus *Tetrops* among the *Cerambycidæ*) they are completely divided.

The antennæ in Coleopterous Insects have their origin generally near the eyes, and are situated for the most part either between them or before them. They are generally composed of eleven joints; in many however this number cannot be traced, whilst in some few there appear to be twelve. The form of the antennæ is extremely variable, and will be best understood by an inspection of the following illustrations, among which will be found most of the more common forms, and some of the more extraordinary.

Fig. 4 represents the head (with one antenna attached) of one of the *Curculionidæ*, a large tribe of beetles, in which the antennæ are what is termed geniculate: that is, they have the terminal joints kneed, or bent at an angle with the basal joint. In describing beetles of this tribe the antenna is generally divided into three parts. The long basal joint (*a*) is called the scapus, the several following joints (*b*) are termed the funiculus, and the terminal joints which form the nob (*c*) clava. *Figs.* 5 and 12 represent antennæ which are termed capitate, or which have the terminal joint or joints suddenly enlarged and forming a knob. When the knob exhibits distinct articulations (*fig.* 5), the antenna is termed capitate with perfoliate knob; and when the knob does not exhibit articulations, or is composed of a single joint, it is said to be capitate with solid knob. Examples of the former will be found in the genus *Necrophorus*, and of the latter in the genus *Monotoma*. *Fig.* 6 represents an antenna which becomes gradually thicker towards the apex, and which is termed clavate. *Fig.* 7 is the antenna of one of a most extraordinary group of beetles, the *Pausidæ*, many of which insects have the knob of that member swollen or inflated. *Fig.* 8 is an auriculate antenna, and is so called from its having an ear-like appendage at its base. This description of antenna is found in the genera *Parnus* and *Gyrinus*. *Fig.* 9 represents the antenna of the common Cockchafer (*Melolontha vulgaris*). This form of antenna, which is termed lamellate, is found throughout the immense tribe of beetles called by Linneus *Scarabæus*, and which has received the name of *Lamellicornes* from this peculiar character.



It must be observed however that slight modifications are found. *Fig.* 10 is a figure of a serrate antenna. Antennæ are so called when they have the apex of the joints widened, so as to resemble the teeth of a saw. Examples may be found in the *Elateridæ* and *Buprestidæ*. Pectinate antennæ (*fig.* 11) are those in which the apex of the joints is produced on one side, and which somewhat resemble the teeth of a comb. There are many examples of this structure in the antennæ of the *Lampyridæ*, &c., and there are some in which the joints are elongated on each side: these are termed bipectinate. *Fig.* 13 is what is called a fissate antenna (the joints on one side divided as by incisures). This form of antenna is found in the genus *Lucanus*. *Fig.* 14 represents a very common form of antenna (where it is slender and tapering gradually to the apex); it is termed setaceous, and most of the *Carabidæ* and *Cerambycidæ* will afford examples. The antennæ termed filiform somewhat resemble the last, but the joints are all of equal thickness throughout. The last description of antennæ which we shall notice are those termed moniliform. (*Fig.* 15.) Here all the joints are oval or round, and resemble a necklace of beads. Examples are found in many of the species of the section *Heteromera*.

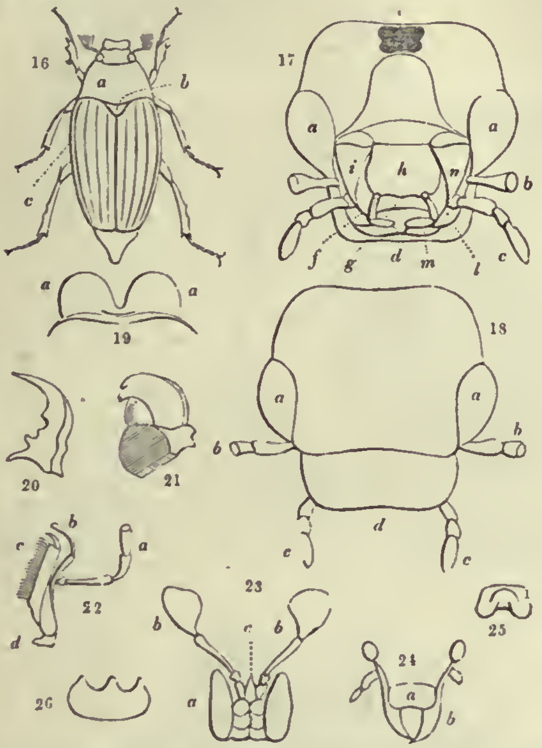
We now come to the parts which constitute the mouth of a beetle; these, it is scarcely necessary to say, are situated in the fore part of the head: they consist of a labrum, or upper lip; two mandibles, or jaws; two maxillæ, or under-jaws; and a labium, or under lip. These are the six principal parts. We shall however also notice the portions called the mentum, or chin, and the clypeus, since they are frequently mentioned in descriptions.

The labrum is a moveable plate, often on the same plane with the fore part of the head, which it terminates, and generally covers the base (at least) of the mandibles above; hence it is often called the upper lip, forming as it does the upper boundary of the mouth.

This portion, although of various forms, is less liable to variation than most of the other parts of the mouth. The most common form perhaps is somewhat quadrate, or broader than long, as in *fig.* 24, *a*.

Upon referring to the article CARABUS, it will be seen that that genus and some other closely-allied genera are separated chiefly on account of the difference in the form of this member. In one it is described as bilobate; by this is meant that the labrum is notched in the middle, so that the two side-pieces form lobes. (*Fig.* 25.) When the labrum is not thus notched, but presents an even anterior margin, it is described as entire. In one of the other genera (*Procrustes*), where the labrum is described as trilobate, the only difference consists in its having two notches on the anterior parts, and is thus separated as it were into three lobes.

The clypeus is the part to which the labrum is attached, and which is usually on the same plane with it. The term clypeus will seldom be found in descriptions, excepting in giving the characters of those beetles which belong to the *Lamellicornes*, a tribe in which this part is greatly developed (*figs.* 17 and 18, *d*), and where the labrum is hidden beneath it.



Under the labrum the mandibles (mandibulæ) are situated. These, as their name implies, are the organs of manducation; they move horizontally, and are most commonly of a shape more or less approaching to a triangle. Their form however varies according to the food of the insect.

Generally speaking, in beetles which feed upon vegetable substances the jaws are broad, obtusely pointed at the apex, and have moreover a broad flat surface at their base (often with little sharp ridges), which somewhat resembles a molar tooth of herbivorous quadrupeds. (*Fig.* 21.) In those species whose habits are carnivorous the jaws are longer and less stout, have the apex acutely pointed, and several sharp tooth-like processes on their inner side. (*Fig.* 20.)

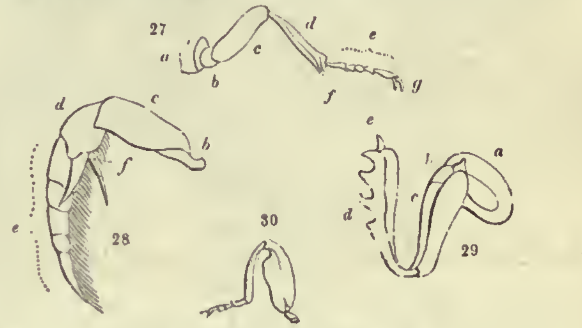
Next in succession follow the maxillæ, or under jaws (*fig.* 17, *n*, and *fig.* 22): these organs are situated beneath the mandibles, and, like them, move horizontally. A typical maxilla consists of several parts, the principal of which are—the hinge (cardo), a piece situated at the base of the maxilla (*fig.* 22, *d*); the maxillary palpus (*fig.* 22, *a*), an articulated organ generally composed of four joints; the outer lobe (lobus superior), which in beetles of carnivorous habits is a two-jointed process (*fig.* 22, *b*) situated between the maxillary palpus and the inferior lobe (lobus inferior), which last portion constitutes the inner part of the maxilla, and is often formed like the blade of a knife, and furnished generally with a series of bristles or hairs on the inner edge. (*Fig.* 22, *c.*) The maxillæ seem to be used with the labium in directing the food during manducation, and the bristles on the inner edge appear to serve as a kind of strainer through which the juices are pressed, for we observe that solid substances are seldom swallowed by insects in their imago state.

The labium, or under lip (*fig.* 17, *h* and *g*, and *figs.* 23 and 26), is a moveable organ which serves to close the mouth beneath, and is generally divided by a transverse suture, in which case the lower portion constitutes the mentum, or chin. The tongue (*fig.* 23, *c*), which may be considered as a portion of the labium, in Coleopterous Insects, is usually situated at the apex of that member, or emerging from it. The labial palpi (*fig.* 23, *b*, *b*, and *fig.* 17, *f*) are two articulated organs usually springing from the summit of the labium on each side.

Having now briefly noticed the head and its parts, we come to the thorax. On this portion it will be unnecessary to dwell: we need only mention that the thorax in insects is composed of the three first segments of the body, which in the larva state are usually distinct; these are termed the prothorax, mesothorax, and metathorax; and it generally happens that in the perfect insect one of these segments is greatly developed at the expense of the other two, particularly on the upper surface of the body; such is the case in the Beetle Tribe, where the first portion or prothorax (*fig.* 16, *a*) and the small plate (*fig.* 16, *b*), which is a part of the mesothorax, are all that is visible from above when the elytra are closed. Some few entomologists, therefore, in describing Beetles, call the part (*fig.* 16, *a*) the prothorax, but it is most commonly called the thorax. The small plate (*fig.* 16, *b*) above referred to is called the scutellum, and is usually of a triangular form.

To the thorax are attached the legs and wings: the anterior pair of legs are attached to the prothorax; to the mesothorax the intermediate pair of legs and the anterior pair of wings, or elytra, as they are termed in the *Coleoptera;* and to the metathorax the posterior pair of legs and the hinder pair of wings. Of the wings enough has been said for the present.

The legs in Beetles vary according to their habits. Thus in some they are formed for running (*fig.* 27), in others for swimming (*fig.* 28); here they are very broad and flat: in others again their structure is suited to burrowing habits (*fig.* 29); and *fig.* 30 represents the hind leg of a beetle, which has the power of leaping to a great distance, where the thigh is very large.



A leg may be divided into five principal parts: the coxa, or hip (*a*, *figs.* 27 and 29), which is the first joint, or that joined to the body, where it plays in a socket; the next part, or second joint of the leg, is the trochanter (*b*, *figs.* 27, 28, and 29); the third is the femur, or thigh (*c*, *figs.* 27, 28, and 29); the fourth joint is called the tibia, or shank (*d*, *figs.* 27, 28, and 29); the fifth and last part is the tarsus (*e*, *figs.* 27, 28, and 29): this part in a great portion of the Coleopterous Insects is composed of five joints; in many a lesser number is found, but in none do they exceed five: the last joint of the tarsus is usually terminated by two hooked claws called unguiculi (*g*, *fig.* 27), and the apex of the tibia is furnished generally with two straight spines called the calcaria (*f*, *figs.* 27 and 28).

As regards the classification of the *Coleoptera*, as well as of insects in general, in almost every work which treats of the subject, a new method is proposed. We shall content ourselves however with noticing two—that which is most commonly adopted on the continent, and that which is followed by most entomologists of our own country: the former is the method proposed by Latreille, and the latter by Stephens.

In the classification of the *Coleoptera*, published by Mr. Stephens in his 'Systematic Catalogue of British Insects,' the various sections and subsections are as follows:—

Order, *Coleoptera*.

Sect. 1. *Adephaga.*	Sect. 3. *Helminthomorpha.*
Sub-Sect. 1. *Geodephaga.*	Sub-Sect. 1. *Rhinchophora.*
2. *Hydradephaga.*	2. *Longicornes.*
3. *Philhydrida.*	Sect. 4. *Anoplurimorpha.*
4. *Necrophaga.*	Sub-Sect. 1. *Eupoda.*
Sect. 2. *Chilognathomorpha.*	2. *Cyclica.*
Sub-Sect. 1. *Clavicornes.*	3. *Trimeri.*
2. *Lamellicornes.*	Sect. 5. *Heteromera.*
3. *Sternoxi.*	Sect. 6. *Brachelytra.*
4. *Malacodermi.*	

The arrangement of Latreille is founded upon the number of joints of the tarsi. He accordingly divides beetles into the four following great sections:—

Section 1. *Pentamera*, including all those Beetles which have five joints to their tarsi.

Section 2. *Heteromera*, Beetles with five joints to the tarsi of the two anterior pairs of legs, and four to those of the posterior pair.

Section 3. *Tetramera*, Beetles with only four distinct joints to all the tarsi.

Section 4. *Trimeri*, Beetles with only three distinct joints to the tarsi.

On comparing these two arrangements, it appears that there is considerable difference of opinion between the authors of them as to the value of certain groups. The *Trimeri*, according to Latreille, is made one of the four great sections, whilst Mr. Stephens makes the same group a sub-section of a tribe of not equal importance with Latreille's first division, the *Pentamera*.

These discrepancies probably arise from the want of some standard by which the importance of characters may be estimated. We find a great number of Insects possessing certain characters in common, but it often happens that we cannot ascertain what influence these characters have on the habits and economy of the individuals. In such instances, the most correct way perhaps would be to judge of the value of a character from its constancy; or, in other words, to consider that character of most importance, as regards classification, which is found in the greatest number of species, these species agreeing more or less in some other points.

In all groups of animals there are however certain typical characters to which all the species approach more or less, and which perhaps the greater portion actually possess. The typical characters of a group, and the departures from them, ought not therefore to be selected for constructing natural and equivalent groups. In the *Coleoptera*, for instance, the typical structure is to possess five joints to the tarsi; Latreille's first section (the *Pentamera*) consequently comprises at least half the species and several distinct groups, each of which is equivalent to one of his other sections.

It appears to us, being guided by the points above mentioned, that the order *Coleoptera* contains the thirteen following distinct sections, and that Latreille's groups are not natural:—

All the Tarsi with five joints.

Section 1. *Geodephaga*, M'Leay.
2. *Hydradephaga*, M'Leay.
3. *Brachelytra*, Latreille.
4. *Necrophaga*, M'Leay.
5. *Palpicornes*, Latreille.
6. *Lamellicornes*, Latreille.
7. *Sternoxi*, Latreille.
8. *Malacodermi*, Latreille.

Five joints to the Tarsi of the two anterior pairs of legs, and four to the posterior pair.

9. *Heteromera*, Latreille.

All the Tarsi with four joints.

10. *Rhyncophora*, Latreille.
11. *Longicornes*, Latreille.
12. *Cyclica*, Latreille.

All the Tarsi with three joints.

13. *Trimeri*, Latreille.

The number of species of Beetles in existence may probably amount to between 30,000 and 40,000.

The principal works on the *Coleoptera* are as follows:—Fabricius (J. C.), 'Systema Eleutheratorum;' Olivier (A. T.), 'Entomologie, ou Histoire Naturelle des Insectes,' five vols. folio, with coloured plates; Paykul (Gustavus), 'Fauna Suecica,' three vols.; Gyllenhal (L.), 'Insecta Suecica;' Schœnherr (C. J.), 'Genera et Species Curculionidum;' Dejean, 'Species Général des Coléoptères;' five volumes of this work are published, and contain descriptions of the genera and species of the *Carabidæ* and *Cicindelidæ*. Besides these, the works of Germar, Illiger, Sturm, Knoch, and Duftschmid may be consulted; and the *Coleoptera* of our own country will be found described in Stephens's 'Illustrations of British Entomology.' The works also of Curtis, Kirby and Spence, Westwood, Newman, and the Transactions of the Linnæan and Entomological Societies, may be consulted with advantage.

COLIBRI. [TROCHILIDÆ.]

COLIUS. [FRINGILLIDÆ.]

COLLEMACEÆ, an order in the Lichenal Alliance proposed by Dr. Lindley, having the following characters:—Nucleus bearing asci; thallus homogeneous, gelatinous, or cartilaginous. Dr. Lindley has given no arrangement of the genera and species of this order in his 'Vegetable Kingdom.' [LICHENS.]

COLLO'MIA (from κόλλα, glue), a genus of Plants belonging to the natural order *Polemoniaceæ*. It has a campanulate calyx, 5-cleft or somewhat 5-parted, the lobes lanceolate or linear, equal, entire; the corolla salver-shaped, with a slender exserted tube, and a spreading 5-parted limb; the segments oblong, entire; the stamens inserted towards the middle of the tube; the anthers ovate-roundish; the cells of the capsule 1-2-seeded. The species are annual herbs, with alternate leaves and dense heads of flowers. They are all natives of America.

C. linearis is an erect branched plant, clothed with glandular hairs; the leaves ovate-lanceolate, quite entire, opaque, reniform, the upper ones downy beneath; the calyx cup-shaped, 5-parted; corolla more than twice as long as the calyx; the cells of the capsule 1-seeded. This plant is a native of North America, from Lake Winnepeg to the western ocean. The corolla has a reddish tube and a rose-coloured limb. The seeds of this as well as the other species are covered with a testa, which is composed of a spiral tissue held together by inspissated mucus. On the seeds being placed in water the gum of the mucus is dissolved, and the spiral fibres start up on the surface of the seed.

The species of *Collomia* are showy plants, and may be easily cultivated in any common garden soil. The seeds should be sown in an open border in spring.

(Don, *Dichlamydeous Plants*.)

COLLOPHORA, a genus of Plants belonging to the natural order *Apocynaceæ*. One of the species, *C. utilis*, yields caoutchouc, or a substance analogous to it.

COLLURICINCLA. [LANIADÆ.]

COLLURIO. [LANIADÆ.]

CO'LOBUS, a genus of Quadrumanous *Mammalia* (Cheiropeds of Mr. Ogilby) established by Illiger and adopted by M. Geoffroy. The latter places the genus in the group of Singes Catarrhins, or Monkeys of the Old Continent; a group distinguished by having their nostrils separated by a very thin partition, and by possessing five molar teeth only on each side of the two jaws.

The genus has the following characters:—Facial angle from 40 to 45 degrees; muzzle short; face naked; body elongated and small; extremities slender; the anterior hands deprived of a thumb; the fingers rather short; the posterior thumb very distant from the fingers, and placed very much backwards; tail longer than the body, small, and tufted at the end; cheek-pouches; and callosities on the buttocks.

The *Colobi*, which are supposed to be inhabitants of the Coast of Guinea, seem to be in the Old World the representatives of *Ateles*, whose locality is South America.

C. polycomos, Geoffroy, is the *Simia polycomos* of Schreber; the *Simia comosa* of Shaw; the Guenon à Camail of Buffon; and the Full Bottom of Pennant. It is a very handsome species. The head and upper part of the body are covered with hair, falling over the shoulders and forming a kind of hood and pelerine, from whence it derives the name given to it by Buffon, while the resemblance of this chevelure to a wig determined Pennant to give it the English name above recorded. This ornament is composed of floating hairs, which are yellow mingled with black; the face is brown, and the rest of the body is covered with very short close hair of a jet-black, a colour which sets off the snow-white tail, which is much longer than the body and not prehensile. In this last particular, in the possession of cheek pouches, and in other characters, it differs from *Ateles*; while in some points, and especially in the absence of the thumb in the anterior hands, it resembles it much.

Full Bottom (*Colobus polycomos*).

It inhabits the forests of Sierra Leone, where the natives give it the name of the 'King of the Monkeys' (Roi des Singes), apparently, says Desmarest, on account of the beauty of its colours, and its 'camail,' which represents a sort of diadem. They attach great value to its fur, of which they make ornaments, and they apply it to various purposes.

C. polycomos, Schreber, with the head and shoulders covered with long coarse flowing hair, of a dirty yellowish colour, mixed with black; body, arms, and legs of a fine glossy blackness, covered with short hair; tail of a snowy whiteness, with very long hair at the end, forming a tuft. (Pennant.) Locality, Sierra Leone.

C. Ursinus, Ogilby, "with very long glossy black hair over the whole body and extremities, and a long snowy-white tail, tufted at the end;" described from two imperfect skins without heads or hands. It is probable that this animal is only a variety or identical with *C. polycomos*.

C. Guereza, Rüppell, with the head, face, neck, back, limbs, and basal half of the tail, covered with short black hair; the temples, chin, throat, and a band over the eyes, white; the sides, flanks from the shoulders downwards, loins and buttocks, clothed with long flowing white, which hangs down on each side like a loose garment; the tip of the tail tufted with dirty-white. Locality, Abyssinia. There is a specimen, one of Dr. Rüppell's, in the British Museum.

Colobus Guereza.

C. ferruginosus, Geoffroy. Crown black; back of a deep bay colour; outside of the limbs black; cheeks, under part of the body, and legs, very bright bay; tail black. Locality, Sierra Leone.

C. fuliginosus. Smoky-blue above, dirty yellowish-gray beneath; cheeks, throat, tail, and extremities, brick-red. (Ogilby.) Locality, the Gambia. Mr. Ogilby observes that the face is short, the head round, and the whole form and habit of the animal similar to those of the *Semnopitheci*. The teeth, he adds, are of the usual form and number, and there are large and very distinct cheek-pouches. "I was the more particular," says Mr. Ogilby, "in making this last observation, because the organs in question had not been previously recorded as existing in the *Colobi*, and because M. Geoffroy St. Hilaire, in his valuable lectures, of which it is a matter of great regret that so small a portion has been given to the public, even doubts their existence." In the 'British Museum Catalogue' this species is given as a synonym of the following:—

C. Temminckii, Kuhl, "with the hands, face, and tail, purplish-red; rest of the members clear-red; belly reddish-yellow; head, neck, back, shoulders, and outer face of the thighs, black." Habitation unknown. Described from a specimen formerly in Bullock's Museum, and now in that of Leyden.

COLOCASIA, a genus of Plants belonging to the natural order *Araceæ*. The species are excessively acrid; the leaves of *C. esculenta* excite a violent salivation and burning sensation in the mouth. Notwithstanding this property many of the species are used as food by the natives of the south of Europe. The leaves and roots of *C. esculenta*, *C. Himalensis*, *C. Antiquorum*, and *C. mucronata*, under the names of Cocoa-Nut, Eddoes, and Yams, when boiled or roasted, are common articles of diet in hot countries. Whole fields of *C. macrorhiza* are cultivated in the South Sea Islands under the name of Tara or Kopeh roots. In the Himalayas the species which is called *C. Himalensis* forms a chief portion of the food of the Hill Tribes. Medicinally the root is stimulant, diaphoretic, and expectorant. The whole of the species are remarkable for containing a milky juice. They are cultivated in Portugal, Greece, and Egypt.

COLOCYNTH. [CUCUMIS.]

COLON. The alimentary canal below the stomach is divided into the small and great intestines. The former consist of the duodenum, jejunum, and ileum; the latter of the colon and rectum. The Colon commences a little above the right groin, in the right iliac fossa [ABDOMEN], in the form of a dilated pouch, which is called the caput coli, or more commonly the cœcum, from its blind rounded extremity. The ileum opens obliquely into the left side of this pouch, its inner or mucous membrane projecting so as to form the ileo-cœcal valve, which, permitting the contents of the small intestine to pass into the Colon, suffices to prevent their return, except in peculiar cases of diseased action. Near the same part of the cœcum opens also a slender contorted intestine about two inches long, likewise blind, which is called the appendix vermiformis, from its resemblance in the human subject to a worm. The use of this appendage is unknown: in some animals, as the sheep, it is much larger, and is probably of more importance than in man. From the right iliac region the Colon passes upwards along the side to the under surface of the liver. Hence it turns to the left, stretching over the upper part of the belly just below and in front of the stomach, to which it is connected by the common attachment of both organs to the omentum, a loose pendulous membrane, formed by a double fold of the peritoneum, and spread like an apron in front of the small intestines. Having reached the opposite side of the abdomen, the Colon passes downwards to the left iliac fossa; thence, taking two sudden turns to the right and downwards, it descends into the pelvis over the last lumbar vertebra, and becomes continuous with the rectum. The double turn just mentioned is the sigmoid flexure; the transverse part is called the arch of the Colon; and the ascending and descending or lateral parts, as they lie immediately over the loins, are called the right and left lumbar portions. The central space thus nearly encircled by the Colon is occupied by the convoluted heap of small intestines. The length of the whole intestinal canal is six or seven times that of the body in man, the Colon constituting about a fifth part. In graminivorous animals its length is proportionably greater; in those which feed exclusively on flesh it is less.

The Colon is enveloped in the serous membrane called the peritoneum, which forms the external covering of all the abdominal viscera. [ABDOMEN.] This outer tunic passing entirely round it, meets behind, and forms a duplicature called the mesocolon, which attaches it, more loosely at the arch than at the sides, to the spine and loins, and serves as a medium for the passage of nerves and vessels, and the lodgment of absorbent glands. Between the peritoneal coat and the interior mucous lining there is a layer of muscular fibres, some of which encircle the bowel in scattered bands, and serve to diminish its calibre; others, more regularly arranged in three distinct longitudinal bands, contract its length; and their combined actions, taking place successively in different parts of the intestine, but on the whole propagated from above downwards, agitate its contents backwards and forwards, and urge them ultimately into the rectum.

The Colon is amply supplied with blood-vessels, nerves, lymphatics, and ducts, which pour out the mucus that lubricates the interior as well as various excrementitious matters here separated from the blood as being injurious or useless. The canal is not smooth and uniform like the small intestines, but bulges out between the bands of muscular fibre into various prominences more or less regular in their form, in which the fæces lodge for a time and become deprived of much of their moisture as they are rolled onwards by the peristaltic action. Hence arises their lobulated or globular form, more observable in some of the lower animals, as the horse and sheep, than in man. It is in the Colon that the fæces acquire their peculiar odour, which is not perceived above the ileo-cœcal valve. It is in this part of the alimentary canal that the fluid part of the food is chiefly absorbed, being no longer needed to keep the nutritive particles in suspension. The lymphatic vessels of the Colon are consequently found distended with a transparent fluid, and not the milk-like chyle absorbed by those of the small intestines. [LACTEALS; LYMPHATICS.]

COLOPHO'NIA (in French the wood is called Bois de Colophane), a genus of Plants belonging to the natural order *Burseraceæ*. It has an urceolar bluntly 3-lobed calyx; 5 roundish-ovate petals inserted under the disc, imbricated in the bud; 6 stamens, one-half shorter than the petals, equal in length to the calyx; the disc 6-lobed. It is to a genus thus defined that De Candolle refers the tree producing the Bois de Colophane of the island of Mauritius, and calls it *C. Mauritiana*. In his description of the tree he says the fruit is unknown. Lindley, in his 'Flora Medica,' gives *Colophonia Mauritiana*, De Cand., *Bursera paniculata*, Lam., *Amyris Zeylanica*, Retz., and *Balsamodendron Zeylanicum*, De Cand., as synonyms of *Canarium commune*. This last is described as a small tree, with 7-11 leaflets on long stalks, ovate-oblong, acute or shortly acuminated, quite entire, smooth; stipules oval; the panicles of flowers terminal, divaricating; the flowers 2-3 together, almost sessile, when young covered over by broad ovate concave silky bracteola; the calyx silky externally; the drupes oblong, black. The bark of this plant yields a limpid oil, with a pungent turpentine smell, which congeals into a buttery camphoraceous substance. It possesses the same properties as Copaiba. Don says:—"When the nuts are mature they contain a sweet kernel, which does not become rancid, and which resembles a sweet chestnut; they are eaten both raw and dressed by the inhabitants of the Moluccas, Banda, and New Guinea; and an oil is expressed from them, which is used at the table when fresh, and for lamps when stale; bread is also made from them, cakes, biscuits, &c., for the table. Eaten fresh they are apt to bring on diarrhœas and dysenteries, and to occasion an oppression at the breast." The same tree is also said to yield East Indian Elemi. It is a native of the continent of India and of the islands of the Eastern Archipelago. (Don, *Dichlamydeous Plants;* Lindley, *Flora Medica.*)

COLOPHONITE, a coarse granular variety of *Garnet*, presenting iridescent hues and a resinous lustre. [GARNET.]

COLOQUINTIDA. [CUCUMIS.]

COLOSSOCHELYS. [CHELONIA.]

COLTSFOOT, the common name of *Tussilago Farfara.* [TUSSILAGO.]

COLUBER. [COLUBRIDÆ.]

COLUBRIDÆ, a family of Snakes, the last of the sub-order *Colubrina* of Dr. J. E. Gray. The *Colubrina* include the families *Hydridæ* [HYDRIDÆ], *Boidæ* [BOIDÆ], and *Colubridæ*. This last family includes the genus *Coluber* of Linnæus, which comprised all the serpents, whether venomous or not, whose scales beneath the tail are divided into two, or, more properly speaking, arranged in pairs; but the term is generally applied by Cuvier and other authors to those serpents which have transverse plates on the belly, and the plates under the tail forming a double row, a flattened head with nine larger plates, teeth almost equal, and no poison-fangs. The following is Dr. Gray's definition of the sub-order *Colubrina*:—Jaws strong, both toothed, sometimes with some fangs in front or grooved teeth behind. Head moderate or indistinct; crown often covered with regular shields. The section of this order to which the *Colubridæ* belong have the belly covered with broad band-like shields; vent without any; spur-like feet; the tail conical and tapering. The only family in this section are the *Colubridæ*, which have the nostrils apical, lateral, open; the head generally shielded.

Laurenti placed the *Colubridæ* between the Rattlesnakes (*Caudisona*) and the Vipers. Scopoli's genera were those of Linnæus. Lacépède placed the *Colubridæ* at the head of his nine genera of Serpents, and next to them came the Boas and Rattlesnakes. Alexander Brongniart made them the last but one of his six genera of Ophidians, arranging them between the Vipers and the Boas. Latreille gave the genus a place between *Chersydrus* and *Dipsas* in his family of Anguivipères. Daudin comprehended 172 species under the genus. In the synoptical table of Duméril and Bibron, Cuvier is made to place it between *Dipsas* and *Cerberus*. Oppel subdivides his section (the second) the *Squammata* (Ecailleux) into seven families, of which the *Colubridæ* (Couleuvrées) are the last, coming immediately after the Pseudo-vipères. Merrem divided the Serpents into two sub-tribes: in the first sub-division, the *Innocui*, or serpents without venom, of the first tribe (*Gulones*), *Coluber* appears between *Scytale* and *Hurriah*. De Blainville separated the Serpents into *Dipodes* and *Apodes; Coluber* coming immediately after *Boa*, is placed in the innocuous division of these *Apodes*. Dr. Harlan made the Ophidians, his fourth order, contain six genera, and placed *Coluber* between *Ophisaurus*, his first, and *Vipera*, his third genus. Mr. Haworth arranged the genus *Coluber* between *Scytale* and *Dryinus*, among the True Serpents (*Apoda epalpebrata*, or serpents without eyelids), and under the innocuous branch of the *Gulonia*. Fitzinger (1826) placed the *Colubroïdes* between the *Pythonoïdes* and the *Bungaroïdes*, in his comprehensive third tribe *Monopnoa squammata*. Ritgen (1828) arranged the *Colubridæ* and the *Boidæ* under his *Macrostomata*, the third sub-partition of the first sub-division, *Holodontaspistes* (with entire teeth), of his third sub-order of Scaly Serpents. Wagler published in 1830 his 'Naturaliches System der Amphibean.' He makes his fourth order, the Serpents, consist of one family only, comprehending 97 genera, and places *Coluber* the forty-ninth between *Spilotes* (Wagler) and *Herpetodrys* (Boié).

In 1832 Professor John Muller, of Bonn, published his system: the Colubers are arranged by him immediately after *Dryinus*, as the last of the Isodonts, the third family of his second order, uniting the *Macrostomes*, which correspond to the *Heterodermes* of Duméril.

The species of the genus *Coluber*, as left by Cuvier, are very numerous, and their geographical distribution is very wide. The foreign species are some of them remarkable for their vivid colouring, and others for the regularity of the pattern, so to speak, with which they are marked. Others again are singularly slender in form, but none grow to a large size.

The harmless Common Snake or Ringed Snake (Neidr fraith, Neidr y tomenydd, of the Welsh, *Natrix torquata* of Gesner and Ray, *Coluber Natrix* of Linnæus) is the best example of the form. [NATRIX.]

COLUBRINA, a genus of Plants belonging to the natural order *Rhamnaceæ*. It has a spreading 5-cleft calyx; petals 5, obovate-convolute; stigmas 3. Fruit capsular, dehiscent, tricoccous, girded at the base by the calyx. The seeds are furnished with a short stalk. The species are shrubs with alternate, quite entire, or crenulated leaves, netted with distant feather-nerves, smooth but usually pubescent or rusty villous. The flowers are in axillary short crowded cymes, or in fascicles with simple peduncles.

C. fermentum, Fermented Snake-Wood, is a native of Guinea; the bitter bark of which tree is said to bring on violent fermentation in the liquors into which it is thrown. There are several other species described, natives of South America, Africa, and the East Indies. None of them are of any known use, and are not worth cultivation except in general collections.

COLUMBA. [COLUMBIDÆ.]

COLUM'BIDÆ, a natural family of Birds, comprising the Pigeons, Doves, and Turtles.

Aristotle mentions five, if not six, birds of this group—Περιστερὰ, Πελειὰς, Φάττα, Οἰνὰς, and Τρυγὼν,—entering at large into their organisation and habits. ('Hist.,' b. i. c. 1; b. ii. c. 15, 17; b. iii. c. 1; b. v. c. 13; b. vi. c. 1, 2, 4, and 8; b. viii. c. 3; b. ix. c. 7.) He also (b. viii. c. 3) speaks of a bird named Φάψ, which Athenæus ('Deipn.,' b. ix. c. 11) and others consider to be one of the *Columbidæ*, while others again hold a different opinion, inasmuch as Athenæus states that Aristotle has distinguished five species of Pigeons, and enumerates Φάψ as one, omitting Πελειὰς; and so Aristotle does (b. viii. c. 3), but he mentions Πελειὰς elsewhere (b. viii. c. 13), and it is clear to us from the context that *Phaps* signified one of the *Columbidæ*, Περιστεροειδεῖς. There is considerable doubt as to which of the species of pigeons Aristotle intended to designate by the terms above given, and some of them have been applied by modern ornithologists to signify forms which he probably never saw. Only two, or at most three, can be identified with anything like certainty. Pliny ('Nat. Hist.,' b. x. c. 34) writes 'De Columbis,' and (c. 35) 'De Palumbibus.' He enters moreover largely into their habits in other parts of his 'Natural History.'

Much doubt seems to have prevailed as to the proper place of the pigeons in the system. Belon collected the few species known to him under the titles Ramiers, Tourterelles, Bisets, Pigeons Fuyards, and Pigeons, among the birds "qu'on trouve viander indifféremment en tous lieux," placing them between the Torcou (*Jynx Torquilla*, Wryneck) and the Merle Bleu (Blue Thrush). Gesner arranged them between the Gallinaceous Birds and the Bustards; Aldrovandus placed them between the Domestic Cock and the Sparrow; Willughby between the Bustards and Thrushes, and Ray gave them the same place. Brisson, Pennant, and Latham insulated them in a particular order. Pennant also arranged them between the Gallinaceous and Passerine Birds, and Latham between the *Passeres* and the *Gallinæ*. Other authors placed them among the Gallinaceous Birds. Linnæus made them a genus of his order *Passeres*, arranging them between *Tetrao* (the Grouse and Partridges, &c.) and *Alauda* (the Larks). Cuvier placed them among the Gallinaceous Birds, next to the Tinamous (*Tinamus*, Latham; *Crypturus*, Illiger), making them the last of the order. In his arrangement the Echassiers (*Grallatores*, Wading Birds) form the order which immediately follows the Gallinacés. Lacépède had previously given them the first place in the last-mentioned family, as did also Duméril. Meyer had insulated them as his seventh order, coming between the *Chelidones* (Swallow Tribe) and his eighth order, *Gallinæ;* and Illiger had found a situation for them under his *Rasores* (the Rasorial Birds). Le Vaillant, who seems to have been the first who separated the *Columbidæ* into well-defined divisions, arranged them in three sections; the first containing the Colombes, Ramiers, and Tourterelles; the second the Colombars; and the third the Colombi-Gallines. Vieillot made them the last family but one (Colombins) of his second tribe (*Anisodactyli*), arranging them between his *Ophiophages* and *Alectrides*. M. Temminck classed them as his ninth order between the Chelidons and the Gallinacés. De Blainville's order *Sponsores*, or Les Colombins, contained these birds, and came between the *Saltatores* (*Passeres*) and the *Gradatores* (Pheasants or Partridges): in his amended method, as developed by M. Lherminier, they occupy nearly the same position between the *Passeres* and the Gallinaceous Birds. C. Bonaparte (Prince of Canino) assigns the same place to them. ('Specchio Comparativo.')

When he wrote the article 'Pigeon' in the 'Dictionnaire d'Histoire Naturelle,' M. Vieillot conformed to the opinion of Linnæus in placing these birds among the *Passeres*, because of its natural great analogy to the last-mentioned group, like nearly the whole of which the pigeons pair in the season of love, the male and female working jointly at the nest, taking their turns during incubation, and participating in the care of the young, which, among the true pigeons, are hatched blind, fed in the nest, which they do not quit till they are covered with feathers, and are supported by their parents some time after their departure from it, having no power to feed themselves. Such are the points of resemblance. Their dissimilarity consists in their mode of drinking and feeding their young, in the nature of their plumage, and the singularity of their courtship and of their voice—points of difference which also separate them from the true gallinaceous birds, with which, says M. Vieillot, they have no analogy in their instincts, their habits, or their loves. Nearly all the gallinaceous birds are polygamous, and lay a great number of eggs each time they incubate, which is rarely more than once a year in the temperate zones; while the true pigeons lay only two eggs each time, incubate frequently during the year, and are monogamous. Among the gallinaceous birds, as a general rule, the male does not solace the female at the time of building the nest and of incubation; the young run as soon almost as they are out of the egg-shell, quitting their nest, and seeking their own food immediately. Finally, a striking character removes the pigeons from the gallinaceous birds, and in M. Vieillot's opinion places them in the same natural group with the *Passeres*, namely, the possession of a posterior toe articulated at the bottom of the tarsus, upon the same plane as the anterior toes, touching the ground throughout its length in walking and embracing the roost in perching. On the contrary, in the gallinaceous birds, the hind toe is articulated upon the tarsus higher than the others, and only touches the ground with its claw, or at most with its first phalanx, and remains perpendicular when the bird is on the perch. Nevertheless it must be confessed that there are found among the pigeons species which participate in some degree with the gallinaceous birds in regard to their manners and gait (allures) or some exterior conformity. Such are the Colombi-Gallines, the Pigeon-Caille of Le Vaillant, to which must be added the Colombi-Gallines of M. Temminck, the Mountain-Partridge of Sloane, the Blue-Headed Pigeon, the Cocotzin, &c., all which have their feet more elongated than those of their congeners, with the wings of the partridges, that is to say rounded, and with the two first quills shorter than the third or fourth; but for the rest, all, with the exception of the Colombe-Galline of Le Vaillant, approach the other pigeons in their amours, their laying, and the bringing up of their young; and so it is of the birds which at Guadaloupe and Martinique bear the name of Partridge; and M. Vieillot quotes Dutertre, who says that "according to the common opinion of the inhabitants of Guadaloupe, there are three sorts of partridges, red, black, and gray, which have never passed in my mind for aught but turtles (tourterelles); for they have not the short quality of flesh belonging to our partridges, they have the straight bill, they perch and build their nests in trees, they only lay two eggs," &c. ('Hist. des Antilles,' tom. ii.) These facts, adds M. Vieillot, have been confirmed to me by the inhabitants of Martinique and Guadaloupe. Of all the pigeons and turtles, continues this ornithologist, which I have had occasion to study in the living state, the Cocotzins are those which appear to me to have the greatest relation to the partridges; their haunt is always in the fields and savannahs; there they seek their food, and never resort to trees; they raise themselves into the air like the partridges, and after a short flight alight upon the ground. For this reason the English and the inhabitants of the United States call it the Ground Dove. But the habit of frequenting the ground, &c. does not belong exclusively to the pigeons whose wings are formed as above stated; for, according to Latham, the *Columba Chalcoptera* (*Phaps*), which M. Temminck arranges with his *Columbæ* (Vieillot's first section), has the same habits, so that the English of Australia call it the Ground Pigeon. (Vieillot.)

"The family of *Columbidæ* (says Mr. Vigors, 'Linn. Trans.,' vol. xiv. p. 410), alternately arranged by systematic writers among the Perching and Gallinaceous orders, and not unfrequently grouped as a separate order between the two, at once indicates where the point of junction exists between them. These birds, although we have the high authority of Linnæus for uniting them with that division of our Perchers which forms his *Passeres*, I do not hesitate in arranging, conformably to the opinion of Messrs. Cuvier and Illiger, as a subdivision of the Gallinaceous Birds.

"In those particulars, where they respectively assume the character of each order, their affinity with the latter is considerably stronger than that which approximates them to the former. Their food and habits, their internal economy, and the formation of their bills, identify them with the *Rasores*; while, on the other hand, the characters which bring them near the *Insessores*, their divided toes and comparatively short legs, are weakened by the resemblance which those members bear to the same parts of the contiguous order in their general structure, and more particularly in the bluntness of the nails, so strongly indicative of the rasorial habits of the Gallinaceous Tribes, and so strikingly contrasted with the sharpness of the nails in the Linnæan *Passeres*. They are much more nearly allied to these latter tribes by their habits of perching and building their nests in trees or rocks, by the absence of the spur on the legs of the male, and by the inferior number of their tail-feathers."

In a note to that part of the text which alludes to the rasorial habits of the Gallinaceous Birds, the author cites the habits of *Columba Nicobarica*, *Columba carunculata*, and *Columba passerina*. Mr. Vigors accordingly places the *Columbidæ* in the aberrant group of his *Rasores*. "I have already observed, when speaking of the affinities," says that ornithologist in the paper above quoted, "which connect the orders of birds together, that the *Columbidæ* form the passage from the *Insessores* to the *Rasores* by their habits of perching and their powers of flight. The hind toe is articulated, as in the Perchers, and their tarsi are shorter, more particularly in the earlier groups, than those of the Gallinaceous Birds in general. The first group which we meet in this extensive family is the genus *Vinago* of M. Cuvier, the bills of which, stronger and more solid than they are usually found to be among the pigeons, unite them to *Penelope* and *Crax*, which form the opposite extreme of the present order, as well as to *Musophaga* and *Corythaix*, which approach, as we have seen, the whole of the groups before us, and connect them with the Perchers. From this genus *Vinago*, which seems confined to the southern divisions of the Old World, we may observe a series of groups leading gradually to the true *Columba*, of which genus the European species *Columba Œnas*, Linn., may be considered to form the type. Hence we are led by several intervening species to the Columbi-Gallines of M. Le Vaillant, which, still retaining the soft and flexible bill of *Columba*, approach the typical Gallinaceous Birds in their more elevated tarsi, and in their habits of living in company and seeking their nourishment chiefly on the ground. Among these may be noticed some forms, *C. Nicobarica*, Linn., and *C. carunculata*, Temm., for instance, which possess the feathered appendages, together with the naked face and caruncles of the Linnæan *Gallinæ*; and another group, the *Lophyrus* of M. Vieillot, which exhibits the size and general form of the same birds, as well as the singular plumes which frequently decorate their head. This last-mentioned genus, formed of the crowned pigeon of India, possessing the strongly-formed leg and foot of *Meleagris*, Linn., but without the spurs, while at the same time it retains the bill of *Columba*, may be observed to open the passage immediately from the present to the succeeding family" (the *Phasianidæ*).

The following remarks embody Mr. Swainson's views upon this interesting family:—"The extensive genus of *Columba*, like that of *Falco*, has been pronounced indivisible by an eminent ornithologist of the present day; who, from having made these birds his peculiar study, is in one sense pre-eminently qualified to give a decided opinion. The principle he has laid down, and on which this opinion consequently is founded, is, that whenever intermediate species are discovered which serve to unite two neighbouring genera, such genera should invariably be united." After stating that this theory has been refuted in the pages of the 'Zoological Journal,' Mr. Swainson thus continues: "It is admitted that there are certain peculiarities of form and of economy among the *Columbidæ*, which point out natural divisions. Some of these have been used for the construction of genera, by Messrs. Le Vaillant, Vieillot, and Cuvier, and of sections by M. Temminck; but the immense number of species already known, and the great influx of new ones, renders it essential that many others should be formed. As we labour under a comparative ignorance of the natural economy of the vast number of tropical species recently described, any attempt to throw the *Columbidæ* into their natural arrangement must be very imperfect. The basis of such a work must rest on their natural habits, their food, and their geographic distribution. Yet, as we see in other natural families that a peculiarity of economy is almost invariably accompanied by some corresponding modification of structure, we shall receive considerable assistance by accurately examining such variations. We may note the forms without being acquainted with their reference to the peculiar habits of the group; and although our inference in some cases may be erroneous, in others we shall not be far from the truth. The passenger-pigeons, for instance, have their first quill-feather as long as any of the others—a sure indication of that rapid and long-continued power of flight they are known to possess. The Columbi-Gallines of M. Le Vaillant are described as having naked and somewhat lengthened tarsi; a structure well adapted to those ambulating habits which bring some of them close to the *Phasianidæ*, Vigors, and others to the *Cracidæ*, Vigors. Another group, the Colombars of M. Le Vaillant (*Vinago*, Cuv., *Tréron*, Vieill.), have a strong hard bill; and their short clasping tarsi covered with feathers lead us to conclude they seldom perch upon the ground; in fact, Messrs. Le Vaillant and Cuvier both assert that these birds are only found in the tropical forests of the Old World. Apparently confined to the same regions, we see another group, wherein the bill partakes of that weak structure observed in the generality of pigeons, while the tarsi are thickly clothed with feathers, similar to the group last mentioned. These seem to be the principal divisions among the *Columbidæ*." In 1827 the same author characterised the genera *Peristera*, *Chæmepelia*, and *Ectopistes*; and in the 'Fauna Boreali-Americana,' under *Columba Ectopistes migratoria*, he has the following note:—"As ornithologists do not appear to be aware of the great difference which exists in the groups of this family in the relative structure of their feet, we shall here draw their attention to the principal groups. In the even-tailed wood-pigeons of Europe, North America, and the Old World, forming the restricted genus *Columba*, the external and internal anterior toes are equal. In the lovely genus *Ptilinopus*, Swainson, confined to the green pigeons of the Indian and Australian isles, and in that of *Vinago*, Cuv., formed by the thick-billed species of the same countries, the inner toe is much shorter than the outer; but in the sub-genus (?) *Ectopistes*, Swainson, and the small turtle doves, this proportion is reversed, the inner toe being the longest. In the beautiful genus *Peristera*, Swainson, which comprises all the bronze-winged pigeons of Australia and the ground-pigeons of America, the tarsi are more elevated, the hind toe shorter, and the inner toe is likewise the longest. We have been for some time engaged in analysing this family, with the view of ascertaining the relative value of all these groups." Dr. Ritgen (1828) makes the genus *Columba*, Linn., form the third family (*Herpochoropteni*) of his first tribe (*Choropteni*), of his second series (*Xerornithes*, or birds of the dry land) in his trichotomous system, as applied to birds.

P. J. Selby, Esq., in the 'Naturalist's Library' (1835), characterises the following genera, *Carpophaga*, *Phaps*, and *Geophilus*. He thus speaks of the classification:—"Of the sub-families or five typical forms of the *Columbidæ*, we can only speak with diffidence and uncertainty, as no analysis of the species sufficiently strict or extensive has hitherto been instituted, from whence conclusive deductions can be drawn. We shall only cursorily observe, that the arboreal pigeons, embracing *Vinago*, Swainson's genus *Ptilinopus*, our genus *Carpophaga*, and some other undefined groups, with feet formed expressly for perching and grasping, and through which, from their habits and form, the necessary connection with the insessorial order is supported, are likely to constitute one; the true pigeons, of which our ring-pigeon and common pigeon may be considered typical, a second; the turtles and their allies, with feet of different proportions from the preceding, and graduated tails, a third; the ground-pigeons, or Columbi-Gallines of the French naturalists, a fourth; and the fifth is not unlikely to be represented by Vieillot's genus *Lophyrus*, in which the deviation from the proper Columbine form is not to that of the typical *Rasores*, but to the *Cracidæ*, placed at the farther extremity, and, like the *Columbidæ*, another aberrant family of the Rasorial order."

Before speaking of the classification of the *Columbidæ*, one part of the internal organisation of the pigeon is worthy of special notice. The crop, in the state which is adapted for ordinary digestion, is thin and membranous, and the internal surface is smooth; but by the time the young are about to be hatched, the whole, except that part which lies on the trachea, becomes thicker, and puts on a glandular appearance, having its internal surface very irregular. In this organ it is that the food is elaborated by the parents before it is conveyed to the young; for a milky fluid of a grayish colour is secreted and poured into the crop among the grain or seeds undergoing digestion, and a quality of food suited to the nestling is thus produced. The fluid coagulates with acids and forms curd, and the apparatus forms, among birds, the nearest approach to the mammæ of warm-blooded animals [BIRDS]; hence no doubt the term 'pigeon's-milk.' The number of vertebræ amounts to 13 cervical, 7 dorsal, 13 sacral, and 7 caudal = 40 (Cuvier). The sternum is narrow, with a deep keel, the inferior border convex, and the anterior one curved forwards, thin, and trenchant; the manubrial process is strong and bifurcated, the costal processes short. The posterior margin is cleft by two fissures on either side of the mesial plane, the lateral and superior fissures being the deepest; the mesial ones are occasionally converted into a foramen. The costal surface of the lateral margin is, as in the gallinaceous birds, of very little extent. In the crown-pigeon the superior fissures are so deep and wide as to convert the rest of the lateral margin into a mere flattened process, which is dilated at the extremity. (Owen.)

The distribution of this family is very extensive, the form occurring almost everywhere, except within the frigid zones. The species are most abundant in Southern Asia and the Great Indian Archipelago.

The following definition includes the *Columbidæ*, to which we shall refer in the present article:—Bill moderate, compressed, covered at the base of the upper mandible with a soft skin, in which the nostrils are pierced, and more or less curved at the point. Feet with three divided toes in front, and one behind.

Vinago (Cuvier).—Bill comparatively large, strong, thick, and solid, compressed at the sides; the tip very hard, hooked, and inflated; the nostrils comparatively exposed, and with the swollen or projecting membrane but little developed. Tarsi short, partly clothed with feathers below the tarsal joint; sole wide, the membrane being extended, and the whole foot formed for perching and grasping; the outer toe longer than the inner, claws strong, sharp, and semicircular, "closely resembling in form those of the woodpecker or other scansorial birds." (Selby.) Wings of mean length, strong and pointed, second and third quills about equal, and the longest in the wing. Mr. Selby says, that in all the species submitted to examination the third quill has the central part of the inner web deeply notched, as if a piece had been cut out; and that the prevailing colours are green and yellow of different intensities, contrasted more or less in certain parts with rich purple and reddish-brown.

The species inhabit Intertropical Asia and Africa. They feed on berries and fruits. They are shy and timid, and inhabit the woods. Mr. Selby gives the following, on the authority of Mr. Neill, who, speaking of *Vinago sphenura*, says: "I had two, but both, I believe, were males. Both had a song, very different from the mere cooing of the ringdove. When they sang in concert, they gave the same little tune, but on different keys. After the death of one the survivor used to sing at command, or, at all events, when incited to it by beginning its tune."

V. aromatica. It is the *Columba aromatica* of Latham. "The Aromatic Vinago is of a mild and timorous disposition, and is generally seen in flocks or societies, except during the period of reproduction, when they pair, and retire to the recesses of the forest. The nest is simple, and composed of a few twigs loosely put together, and the eggs are two. . . . . The base or softer part of the bill is a blackish-gray, the tip yellowish-white, strong, much hooked, and bulging on the side. The forehead is of a bright siskin-green, the crown greenish-gray, the chin and throat gamboge-yellow, the remainder of the neck, the breast, belly, lower back, and rump, yellowish-green. The upper back or mantle, and a part of the lesser wing-coverts, are of a rich brownish red, and exhibit a purplish-tinge in certain lights. The greater wing-coverts and secondary quills are greenish-black, with a deep and well-defined edging of gamboge-yellow throughout their length. The tail has the two middle feathers wholly green, and slightly exceeding the rest in length; these are of a dark bluish-gray, with a dark central band. The under tail-coverts are yellowish-white, barred with green. The legs and toes are red, the claws pale gray, strong, sharp, and semicircular." (Selby; and see Temminck.)

Aromatic Vinago (*Vinago aromatica*).

It inhabits the continent of India, Java, and other adjacent islands.

The habits of this species are arborial. Mr. Selby, gives the following note which accompanied the skins of *V. militaris*, and *V. aromatica*. "Green Pigeon.—This beautiful bird has brilliant red eyes. Its feet are something like the parrot's, and it climbs in the same way as that bird. It is very difficult to find; for although a flock is marked into a tree, yet its colour is so similar to the leaf of the banyan (on the small red fig of which it feeds), that if a bird does not move you may look for many minutes before you can see one, although there may be fifty in the tree."

Ptilinopus (Swainson).—Wings moderate, first quill contracted towards the apex, third and fourth longest. Bill slender. Tarsi feathered.

Mr. Swainson says that in proposing the characters of this genus, he wishes them to be considered more as indicating a group, by which the genus *Tréron*, Viell. (*Vinago*, Cuv.), may be united to the naked-legged pigeons, than as being so rigidly framed as to exclude all other species which do not strictly present the same structure.

Mr. Selby, in the 'Naturalist's Library,' feels inclined to still further subdivide the group, restricting the genuine title of *Ptilinopus* to that group of smaller pigeons in which the first quill-feather becomes suddenly narrowed or attenuated towards the tip, and the tarsi are feathered almost to the division of the toes.

The species inhabit the Moluccas, the Celebes, and the islands of the Pacific (Selby.) Their habits are retired; they live in forest solitudes. Food, fruits and berries.

The following is a description of the genus as restricted by Mr. Selby:—Bill comparatively slender, the base slightly depressed, and the soft covering of the nostrils not much arched or swollen; the tip though hard is little inflated, with a gentle curvature; the forehead is rather low and depressed; the legs are short but strong; the tarsi clothed with feathers nearly to the division of the toes; the feet are calculated for grasping, and are similar in form to those of *Vinago*, the sides of the toes being enlarged by the extension of the lateral membrane, and the outer longer than the inner one; the wings are strong, and of moderate length, the first quill-feather considerably shorter than the second, and suddenly narrowed towards the tip—a peculiarity also possessed by several pigeons belonging to other distinct groups, and by which means the connexion is thus kept up between them. The third and fourth quills are nearly equal to each other, and are the longest in the wing. The tail is of proportionate length, and generally square at the end. Predominating colour like that of *Vinago*, green, varied in parts with yellow and orange, and in some, beautifully encircled with masses of purplish-red and vivid blue.

P. cyano-virens. It is the *Columba cyano-virens* of Lesson, who described it in the 'Voyage de la Coquille.' The bird is termed Manasope in the Papuan tongue, and inhabits, says Lesson, the profound and still virgin forests (encore vierges) of New Guinea. "It was in the neighbourhood of the harbour of Doréry that we procured the greatest number of individuals. Their low cooing was heard frequently from the large trees, and every thing indicated that they were common."

Ptilinopus cyano-virens.

Description.—Total length from the end of the bill to the extremity of the tail, 8 inches 6 lines (French); bill delicate and black; iris of a red-brown; tarsi short, and nearly entirely feathered; toes with a membranous border, and of a lively orange colour; head, rump, upper part of the body, wings, and tail, of an agreeable grass-green; a large patch (calotte) of a beautiful indigo-blue covers the occiput; elongated blue spots occupy the centre of the subalar feathers, which are bordered with a straight yellow line; the internal and hidden part of the same feathers is brown; the quills are entirely brown, and bordered at the external edge with a line of canary yellow; the tail is square and rectilinear; the feathers which compose it are fourteen in number, brown, their extremities white below, and of a green similar to that of the back above, passing into black in the middle, and each terminating within with a white spot; the two exterior ones are brown, bordered with yellow externally, as are the two or three next; the shaft is brown; the throat to half-way down the neck is ash-gray; the breast is grayish-green; the belly and the flanks are at first green mingled with some yellow borderings, and then comes a large patch of yellowish-white extending on each side so as to form a kind of girdle; the feathers of the thighs are green; those of the vent, white and pale yellow; the lower tail-coverts are yellow mingled with green. M. Lesson mentions another individual rather smaller, with some differences of plumage, which he supposes to have been either a female or a young one. Mr. Selby remarks upon the fact that no notice is taken of the form of the first quill-feather in this description, and regrets it, but entertains little or no doubt of its presence in nearly a similar form to that assumed by the rest of this group, of which *P. purpuratus* is the type.

Carpophaga (Selby).—"In this group," says Mr. Selby, "which is composed of birds of a much larger size than the preceding, the wings, though possessing the same relative proportions, have no emargination, or sudden narrowing of the tip of the first quill. Their tarsi also are not so thickly or entirely feathered; and their nostrils are placed nearer to the base of the bill. In some species, green, yellow, and purple are the prevailing colours; in others, a rich bronzed or metallic colour composes the upper plumage, exhibiting shades of deep green and purple, according to the light in which it is viewed, while in those which lead the way to the typical pigeons, the tints become less vivid and more uniform in their distribution. Their bill is considerably depressed at the base, the membrane in which the nostrils are placed but little prominent or swollen, the tip compressed and moderately arched, the tomia slightly sinuated. The forehead is low, and the feathers advance considerably upon the soft portion of the bill. In many of them a caruncle, or gristly knob, varying in size and shape according to the species, grows upon the basal part of the upper mandible during the season of propagation. This is supposed to be common to both sexes, as the female is described with it in Duperrey's 'Voyage.' After this epoch it is rapidly absorbed, and its situation scarcely to be observed upon the surface of the bill. The feet are powerful, and formed for grasping, the soles being flat and greatly extended. As in the other members of this group, the hind toe is fully developed and long, and the exterior longer than the inner toe. They inhabit the forests of India, the Moluccas, Celebes, Australia, and the Pacific Isles. Their food consists of fruits and berries. That of the precious nutmeg, or rather its soft covering, known to us by the name of mace, at certain seasons affords a favourable repast to some species, and upon this luxurious diet they become so loaded with fat as frequently, when shot, to burst asunder when they fall to the ground. And here we may remark on the remarkable provision nature has made for the propagation as well as the dissemination of this valuable spice; for the nutmeg itself, which is generally swallowed with the whole of its pulpy covering, passes uninjured through the digestive organs of the bird, and is thus dispersed throughout the group of the Moluccas and other islands of the east. Indeed, from repeated experiments, it appears that an artificial preparation analogous to that which it undergoes in its passage through the bird, is necessary to ensure the growth and fertility of the nut; and it was not till after many unsuccessful attempts had been made that a lixivium of lime, in which the nuts were steeped for a certain time, was found to have the wished-for effect, and to induce the germinating tendency. The fruit of the Banyan (*Ficus religiosa*), the sacred tree of the Hindoos, is also a favourite repast of all the pigeons of this group, as well as of the stronger-billed *Vinago*."

C. oceanica. It is the *Columba oceanica* of Lesson. This species, according to Lesson, is the Moulouesse, or Mouleux, of the natives of Oualan, and though it approaches the Nutmeg Pigeon, *Columba* (*Carpophaga*) *ænea*, very nearly, it differs from it in size, being one-third less, and in the distribution of some of its colours. "The Nutmeg Pigeon lives more particularly in the eastern Moluccas, and especially at New Guinea and Waigiou, while the Oceanic Fruit-Pigeon is abundant in the little isle of Oualan, in the midst of the great archipelago of the Carolines, and seems to exist in the Pelew Islands, where Wilson mentions it under the name of cyep." Lesson further observes, that it may be possibly spread over the Philippines, and at Magindanao.

Oceanic Fruit-Pigeon (*Carpophaga oceanica*).

Description.—Total length, 14 inches (French), including the tail, which measures five; the bill, an inch long, is black, strong, and surmounted at its base by a rounded and very black caruncle; the feet are very strong and of a bright orange colour; the tarsi are feathered nearly down to the toes, which have a well-developed border; the wings are pointed, and only one inch shorter than the tail, which is almost rectilinear. The feathers of the forehead, cheeks and throat, are whitish mixed with gray; the head and the back of the neck are of a deep slaty gray; the back, rump, wing-coverts, quills, and tail-feathers, are of a uniform metallic green, passing into brown on the interior of the great feathers; the breast and upper part of the belly are gray, with a tint of rust-colour; the lower part of the belly, the vent, the thighs, and the lower tail-coverts, are a deep ferruginous red; the tail-feathers on the under side are a bright reddish-green (vert rougeâtre clair). (Lesson.)

M. Lesson thinks that this, very probably, is the species mentioned by "the celebrated naturalist, Forster (and not Captain Forster, as the reading is, twice, in M. Temminck's work, tom. i. p. 89, 8vo), who observed in the Isle of Tanna, one of the New Hebrides (Cook's 'Second Voyage,' vol. iii. p. 179, 4to), a Nutmeg Pigeon of the same species as that which occurred at the Friendly Islands."

The caruncle shown in the cut is dissipated after the breeding season, leaving nothing but a slight cutaneous wrinkle. M. Lesson says that the bird feeds on a berry which is very abundant in the small Isle of Oualan, and that it is not disturbed by the natives.

Mr. Selby gives as a form apparently belonging to this division of the *Columbidæ*, the following species: *Columba Phasianella* (Temm.), the structure of the bill being, as he observes, intermediate between that of *Vinago* and *Columba*, and the feet formed upon the same plan as those of the rest of the *Ptilinopinæ*.

Description.—Length from 14 to 16 inches, the tail being seven, and rather more. Wings short, reaching, when closed, about an inch and a half beyond the root of the tail, rounded, and with the third quill longest; the first and fourth being equal to each other. Bill, measuring from the forehead, nearly three quarters of an inch long; the tip of the upper mandible moderately arched, and with a notch; that of the lower angulated and strong; throat, yellowish-white; head, sides, and front of the neck, and whole of the under plumage orange-brown; hinder part of the neck changeable rich violet-purple, with brilliant gold reflections; back, wing-coverts, and the rest of the upper plumage, deep reddish-brown, shot with bronze in some lights; tail graduated or cuneiform, the two middle feathers brown, the lateral marked obliquely with a black bar; feet and naked part of legs reddish-brown; sole of the hind and inner toes much expanded.

Young differing from the adult in having the neck dirty reddish-brown, with narrow bars of black; belly of a pale reddish-gray, minutely and darkly speckled; back inclining to hair-brown; and smaller wing-coverts deeply edged with orange-brown.

M. Temminck first described the species in the 'Linnæan Transactions,' from an Australian specimen. It has since been observed in most of the Philippine and Molucca Islands, Java, &c.

Columba Phasianella is an inhabitant of the woods. Its food is said to consist of a kind of pimento and of other aromatic berries, swallowed entire. The flesh is dark, but its flavour is stated to be excellent.

Columba Phasianella.

Mr. Selby makes the group to contain *Columba Macroura*, Auct.; *C. nuchalis*, Wagler; and *C. Reinwardtii*, Temm. "Of its precise situation," says Mr. Selby, "in the circle of the *Columbidæ*, we speak with some degree of doubt, not having had an opportunity of instituting so strict an analysis of the species as the subject requires; but we believe it will be found to enter among the *Ptilinopinæ*, or arboreal pigeons, as the feet and tarsi of its members are similar in form to those of that division, the latter being very short and partly plumed below the joint, the former with the exterior toe longer than the inner, and the hinder toe fully developed; the sole of the foot, by the extension of the membrane, is broad and expansive, and the claws are arched and strong, all of which are characters evidently showing these members to be expressly adapted for perching and prehension, and not for gressorial movements. The bill also in one species (*C. Reinwardtii*) approaches in point of strength nearly to that of *Vinago*, and in all of them the tip of both mandibles is hard and firm, the upper one with a visible emargination and moderately arched. Their habits and mode of life are also nearly allied to the other arboreal species, being the constant inhabitants of the woods, and subsisting upon the fruits and berries of various trees and shrubs. M. Temminck, in his description of this species, says that it possesses a structure and form precisely similar to that of the *C. migratoria* of North America. To this we cannot subscribe, seeing that its essential characters, as above described, are different, and that the only point of resemblance consists in the length of the tail. Indeed, so far removed do we think it from the American group, that we cannot consider it as its analogue in the Asiatic regions where it resides."

Columba, Auct.—Most ornithologists are agreed that the sub-family *Columbinæ* contains the type of the form of the *Columbidæ*, and that we are to look among the species of our own country for that type. The Ring-Pigeon, Cushat or Queest (*C. Palumbus*), the Wood-Pigeon (*C. Œnas*), and the Rock-Pigeon or Biset (*C. livia*), are considered to be the forms in which the peculiarity of structure and habits of the family are most perfectly developed, and of these *C. Palumbus* is generally taken as the typical point of comparison. The *Columbinæ* are distinguished by a bill of moderate strength, with a hard tip, bulging and somewhat arched. The nostrils are partly clothed by a soft membrane, and the orbits of the eyes are more or less denuded of feathers. The feet may be called both gressorial and insessorial; for they are so organised, that the action of walking or perching may be performed at pleasure, for the back toe is moderately long, and the claws are so formed and placed as not to interfere with terrestrial progression, while they are at the same time calculated for arboreal prehension. In the types the exterior and interior toes are of equal length. The wings are fully developed and somewhat pointed; the second and third quills are the longest. The tail is generally square, and moderately long.

"In those species," says Mr. Selby, in the work above quoted, "which are the media of connection with other groups, the above characters become partially modified, as we see exemplified in the species nearest allied to the *Ptilinopinæ*, or arboreal pigeons, their feet losing the true character of that of the common pigeon, and assuming more of the grasping form than that fitted for progress upon the ground."

The species are very numerous, and spread over every quarter of the globe.

"The prevailing colour of the pigeons is bluish-gray, of various intensities and shades, frequently embellished upon the neck with feathers having a metallic lustre and peculiar form, and which exhibit various tints of colour according to the light in which they are viewed. They are naturally birds of a wild and timid disposition (though one species has been partly reclaimed), and usually live congregated in extensive flocks, except during the season of reproduction, when they pair. Most of the species seek their food upon the ground. This consists of the different *Cerealia*, as also acorns, beech-mast, and other seeds, and occasionally of the green and tender leaves of particular plants. Their flesh is sapid and nutritious, being of a warm and invigorating nature. Their flight is powerful, very rapid, and can be long sustained, and many species are in the habit of making distant periodical migrations. They are widely disseminated, species of the genus being found in every quarter of the globe, and in all climates, except the frozen regions of the two hemispheres. They build in trees or holes of rocks, making a shallow nest of small twigs loosely put together. Their eggs are never more than two in number, their colour a pure white; they are incubated alternately by both sexes, and are hatched after being sat upon from eighteen to twenty-one days. The young, upon exclusion, are thinly covered with down, which is rapidly succeeded by the proper feathers." (Selby.) The apparatus for preparing the food for the nestlings has been before adverted to.

C. spadicea. Mr. Selby places this species as connecting the arboreal species with the typical pigeons, but arranges it under the *Columbinæ*, not without doubt, "for although it presents characters in some of its members approaching those of the pigeons, it cannot be denied that, in its general appearance, and the metallic lustre of its plumage, it also shows evident marks of a near affinity to several species of the genus *Carpophaga*, and it might perhaps with equal propriety be placed at the extremity of that group;" and regrets the little information extant of its peculiar habits and mode of life, which would have assisted in forming a more satisfactory conclusion as to its proper position. He adds, that from the form and size of the feet we may judge that its habits are more those of an arboreal than terrestrial bird, though its claws want the great curvature of those of the *Ptilinopinæ*, and show its capability of occasionally resorting to the ground for food. M. Lesson, who killed many individuals of this brilliant pigeon, described by Latham and figured by Temminck, says that its flesh is excellent, and that it is very abundant in the woods about the Bay of Ipiripi, or the Bay of Islands. The first which he procured was killed and sent to the expedition by one of the officers of the Coquille; and Toui, chief of the hippah of Kaouera, near which she was moored, brought them frequently on board. He adds, that the individual described by Latham as the Chestnut-Shouldered Pigeon came from Norfolk Island, not far from New Zealand, and that M. Temminck indicates the Friendly or Tonga Islands as its native country. This locality M. Lesson, from whom the following description is taken, seems to doubt.

Total length, 16¼ inches (French)—English authors give it as from 19 to 20 inches; tail 6 inches, nearly rectilineal, and slightly notched; bill rather swollen near the point of the lower mandible, of a brilliant carmine at its base as well as the feet, the tarsi of which are feathered almost to the toes. The eyes are surrounded with a bright-red membrane, and the iris is of the same colour. All the upper parts of the bird, the back, the rump, the wings, and the throat, are of a changeable hue, in which are mingled rosy copper-reflections running into brilliant and iridescent tints, but becoming more sombre upon the great quills. The plumage of the breast, belly, vent, and tarsi are pure white. The upper part of the tail is brown, slightly tinged with greenish; and below it is brown, which is deepest within and at the extremity.

Columba spadicea.

C. dilopha. "In this curious species," says Mr. Selby, "besides the occipital crest, an ornament which is found in many other birds, there is an additional one in front, composed of long recurved and lax feathers, which not only occupy the forehead, but also the superior part of the soft or basal portion of the bill. This double crest gives the head of the pigeon a character unlike any of its congeners, and more resembling that of some of the crested *Phasianidæ* or *Cracidæ*, with which an analogical relation is thus sustained. In other respects

Columba dilopha.

its characters agree with those of *C. spadicea*, the proportion of the wings and the form of the feet being nearly the same. Temminck, who first described it, observes, "Cette nouvelle espèce a le plus de rapports dans toutes ses formes avec la *Columba spadicea*, et toutes les deux sont très peu différentes de notre Ramier d'Europe."

The size of this bird is nearly that of *C. spadicea.* Wings long and powerful, reaching when closed beyond the middle of the tail, second, third, and fourth feathers longest and nearly equal, fifth shorter than the first. Bill rich orange, tip of under mandible obliquely truncated, tip of upper mandible compressed, somewhat arched, culmen rounded. Frontal crest beginning on the upper part of the bill immediately behind the horny tip and above the nostrils, composed of long curved feathers, soft and loose in texture, and bluish-gray tinged with rufous in colour, pointing backwards. Occipital crest rich rufous, bounded on each side from the posterior angle of the eye by a streak of glossy black, decumbent, composed also of long soft feathers with open barbules, each feather widening towards the tip. Side and front of neck and breast pale gray, black at the base of the feathers, which is hid. The feathers here are trifid at the end: on the back of the neck they are acuminated, but not distinctly divided as upon the breast. Back, scapulars, and wing-coverts deep bluish-gray, the feathers darker at the margin; quills and secondaries bluish-black; under plumage gray. Tail square, basal part and narrow band pale gray tinged with reddish, tip and broad intermediate bar black; length 7 inches. Naked parts of tarsi and toes crimson-red; hind toe strong, with a broad flat sole, and exceeding the tarsus in length; nails long and somewhat curved. It is found in Australia and Java.

C. Palumbus, the Cushat. It is the Ramier of the French; Torquato, Ghiandaria, &c., of the Italians, according to Belon; Colombaccio, Palombo, Piccione da Ghianda of the same, according to Prince Bonaparte; Ringdufwa of the 'Fauna Suecica;' Wild-Taube and Ringel-Taube of the Germans; Ring-Dove, Queest, and Cushat of the British; Ysguthan of the Welsh, and in Belon's opinion the Φάττα of the Greeks.

The Cushat most probably sat for the pretty picture of Virgil's 'aëriae palumbes.' It is considered the type of the *Columbinæ*. Instances have been known of its laying in aviaries, and Mr. Selby states that a pair of ring-pigeons in one of the aviaries of the Zoological Gardens "built their nest in a tree or shrub contained within it, and that the female laid two eggs, which unfortunately were destroyed by some accident during incubation. This fact shows that under favourable circumstances, and when the habits of the bird are attended to, a progeny may be obtained."

C. Œnas. It is the Palombella, Palombella di Macchia, Piccione Topacchio of the Italians; Le Pigeon Sauvage of Brisson; Stock-Dove and Wood-Pigeon of the British. Mr. Selby observes, "Near as it approaches the common pigeon in size and form, no mixed breed that we are aware of has ever been obtained between them, although repeated attempts to effect an intercourse have been made. This in our mind appears a strong and convincing proof that all the varieties generally known by the name of Fancy Pigeons have originated from one and the same stock, and not from crosses with other species, as some have supposed, the produce of which, even could it be occasionally obtained, we have no doubt would prove to be barren, or what are generally termed mules."

C. livia. This—the Pigeon Privé of Bélon; Le Pigeon Domestique, Le Biset, and Le Rocheraye, of Brisson; Coulon, Colombe, Pigeon, of the French; Palombella, Piccione di Torre, Piccione di Rocca, of the Italians; Feld-Taube, Haus-Taube, Hohl-Taube, Blau-Taube, and Holtz-Taube, of the Germans; Wild Rock-Pigeon of the British; Colommen of the Welsh—is the stock from which ornithologists generally now agree that the domestic pigeon and its varieties are derived. "Under this species," writes Mr. Selby, "we include not only the common pigeon, or inhabitant of the dove-cot, but all those numerous varieties, or, as they are frequently termed, races of domesticated pigeons, so highly prized, and fostered with such care and attention by the amateur breeder or pigeon fancier; for, however diversified their forms, colour, or peculiarity of habit may be, we consider them all as having originated from a few accidental varieties of the common pigeon, and not from any cross of that bird with other species, no signs or marks whatever of such being apparent in any of the numerous varieties known to us. In fact, the greater part of them owe their existence to the interference and the art of man; for by separating from the parent stock such accidental varieties as have occasionally occurred, by subjecting these to captivity and domestication, and by assorting them and pairing them together as fancy or caprice suggested, he has at intervals generated all the various races and peculiar varieties which it is well known when once produced may be perpetuated for an indefinite period, by being kept separate from and unmixed with others, or what by those interested in such pursuits is usually termed 'breeding in and in.' Such also, we may add, is the opinion of the most eminent naturalists as to their origin, and it is strongly insisted on by M. Temminck in his valuable work the 'Histoire Générale Naturelle des Pigeons.' Indeed the fact that all the varieties, however much they may differ in colour, size, or other particulars, if permitted, breed freely and indiscriminately with each other, and produce a progeny equally prolific, is another and a convincing proof of their common and self-same origin; for it is one of those universal laws of nature, extending even to plants, and one which if once set aside or not enforced would plunge all animated matter into indescribable confusion, that the offspring produced by the intercourse of different species, that is, distinct species, is incapable of further increase. That such an intercourse may be effected is well known to all; but it is generally under peculiar or artificial circumstances, and rarely when the animals, birds, or whatever they may be, are in their natural state, and in a condition to make their own election. It is seen in the crosses obtained in a state of confinement between the canary and goldfinch, linnet, &c.; in the hybrids between different species of *Anatidæ*, when domesticated or kept in captivity; in the cross between the pheasant and common fowl, &c. . . .

"The bastard produce of the common wild turtle (*Turtur communis*) with the turtle of the aviary (*Turtur risorius*) has been proved by frequent experiments to be barren, although the two species from whence it originates appear to be closely allied, and a mixed breed is easily procured; and such, we have no hesitation in saying, would be the event if a cross could be obtained between the common pigeon and the ring pigeon, the wood pigeon, or any other species." These observations are well worthy of attention. The assertion respecting the bastard produce of the turtles, made above, is corroborated by Messrs. Boitard and Corbié in their 'Histoire des Pigeons de Volière,' and the principle is further confirmed by the experiments of Mauduyt, Vieillot, and Corbié.

The varieties of this bird produced under the fostering hand of man, the tumblers, croppers, jacobines, runts, spots, turbits, owls, nuns, &c. &c., would fill a volume. Our limits will not permit us to figure or describe them. The Carrier however demands notice. In one of his odes (Εἰς Περιστερὰν) Anacreon has immortalised it as the bearer of epistles. Taurostheues sent to his expectant father, who resided in Ægina, the glad tidings of his success in the Olympic games on the very day of his victory. Pliny ('Nat. Hist.,' book x. 37) speaks of the communication kept up between Hirtius and Decimus Brutus at the siege of Mutina (Modena): "What availed Antony the trench and the watch of the besiegers; what availed the nets (retia) stretched across the river, while the messenger was cleaving the air (per cœlum eunte nuntio)." The Crusaders employed them, and Joinville records an instance during the crusade of Saint Louis. Tasso 'Gierusalemme Liberata,' cant. xviii. sings of one that was attacked by a falcon and defended by Godfrey,

> "Che dal colle ad un filo avinta pende
> Riachiusa carta, e sotto un' ala ascosa."

which 'carta' Godfrey of course reads, and is put in possession of all the secrets. In the same way Ariosto (cant. xv.) makes the 'Castellan di Damiata' spread the news of Orrilo's death all over Egypt. Sir John Maundeville, knight, warrior, and pilgrim, who penetrated to the border of China in the reigns of our Second and Third Edward, thus writes: "In that contree and other contrees bezonde thei han a custom, whan thei schulle usen werre, and whan men holden sege abouten cytee or castelle, and thei withinnen dur not senden out messagers with lettere fro lord to lord, for to aske sokour, thei maken here letters and bynden them to the nekke of a *Colver*, and letten the Colver flee; and the Colveres ben so taughte that thei fleen with the letters to the very place that men wolde sende hem to. For the Colveres ben norysscht in tho places where thei ben sent to; and thei senden hem thus for to beren here letters. And the Colveres retournen azen where as thei ben norisscht, and so they don comonnly."

The Carrier however gradually sank, in this country at least, to the bearer of the intelligence of the felon's death at Tyburn—Hogarth's print will occur to every body: it became the messenger from the race-course and prize-ring, and was also largely used in stock-jobbing transactions. The invention and application however of the electric telegraph has to a considerable extent superseded the use of the Carrier-Pigeon.

Some idea of the astonishing fecundity of the domesticated pigeon may be derived from the assertion of Biberg, who observes that if you suppose two pigeons to hatch nine times a year they may produce in four years 14,760 young.

In its wild state the Rock Pigeon is widely distributed; the rocky islands of Africa and Asia, and in the Mediterranean, abound with them. Virgil's beautiful simile in the Fifth Æneid evidently relates to this species:—

> 'Cui domus et dulces latebroso in pumice nidi.'

In the Orkneys and Hebrides it is said to swarm. "It is also met with upon the northern and western coasts of Sutherland, the perforated and cavernous rocks which gird the eastern side of Loch Eriboll, and those of the limestone district of Durness, furnishing suitable places of retreat; and again upon the eastern coasts of Scotland it is seen about the rocky steeps of the Isle of Bass and the bold promontory of St. Abb's Head." (Selby.)

C. livia in its wild state has the following characters:—Bill blackish-brown; the nostril membrane red, sprinkled as it were with a white powder. The irides pale reddish-orange. Head and throat bluish-gray. Sides of the neck and upper part of the breast dark lavender-purple, glossed with shades of green and purplish-red. Lower part of breast and abdomen bluish-gray. Upper mandible and wing-coverts blue-gray. Greater coverts and secondaries barred with black, so that there are two broad and distinct bars across the closed wings. Lower part of the back white; rump and tail-coverts bluish-gray. Tail deep gray, with a broad black bar at the end. Legs and feet pale purplish-red. Wings when closed reaching within half an inch of the end of the tail. (Selby.)

Wild Rock-Pigeon (*Columba livia*).

Turtur (*Ectopistinæ*, Selby).—Bill more slender than that of the pigeons. Tip of the upper mandible gently deflected, that of the lower scarcely exhibiting the appearance of an angle. Tarsi rather shorter than the middle toe. Feet formed for walking or perching; inner toe longer than the outer. Front of tarsi covered with broad imbricated scales. Wings—first quill a little shorter than the second, third longest of all. Tail rounded or slightly graduated. (Selby.)

T. risorius. It is the *Columba risoria* of authors; *T. torquatus Senegalensis*, Brisson; Tourterelle à Collier, Buffon; probably the Turtle of the Scriptures, and still plentiful in Egypt and other eastern countries, where it is often kept in confinement. The relics of Greek and Roman art give a very fair representation of this species; but Bélon and others seem to be of opinion that the *T. communis*, Common Turtle Dove, was the Τρύγων of the Greeks.

Turtur risorius.

The following is a description of a wild specimen from Southern Africa:—Length about 10 inches. Chin whitish; from the corners of the mouth to the eyes a narrow streak of black. Forehead pale bluish-gray; crown darker; cheeks, neck, breast, and belly, gray, tinged with vinaceous or pale purplish-red; the hind neck with a demi-collar of black; some of the side feathers of the collar tipped with white. Back, scapulars, and rump, pale clove-brown, with a greenish tinge. Margins of wings, greater coverts, and under wing-coverts, blue-gray. Greater quills hair-brown, delicately edged with grayish-white. Vent and under tail-coverts white. Legs and feet gray; inner toe a little longer than the outer. (Selby.)

In its natural state this species haunts the woods, where it breeds, making a nest like that of the common turtle, and lays two white eggs. It seeks its food in the open grounds, and subsists upon grain, grass-seeds, and pulse, &c. Its trivial name is derived from a fanciful resemblance to the human laugh in its cooings. (Selby.)

A race between the common turtle and this species has been obtained; but the mules are stated to have been invariably barren.

T. communis (Linnæus), the Turtle Dove (*Columba turtur* of authors), is found in Great Britain. It occurs only as a summer visiter coming from Africa.

Mr. Selby provisionally places the *C. lophotes* of Temminck under this genus.

Ectopistes (Swainson).—Bill slender, notched. Wings rather elongated, pointed; the first and third quill equal; the second longest. Tail rounded, or curvated. Feet short, naked; anterior scales of the tarsi imbricate; lateral scales very small, reticulate.

E. migratoria. It is the *C. migratoria* of authors, the Passenger Pigeon of Wilson, Audubon, and others. Our limits not allowing us to give a detailed history of any length of the habits of more than one species, we have selected Wilson's graphic account of this elegant bird as the most striking:—

Passenger Pigeon (*Ectopistes migratoria*).

"The roosting-places are always in the woods, and sometimes occupy a large extent of forest. When they have frequented one of those places for some time, the appearance it exhibits is surprising. The ground is covered to the depth of several inches with their dung; all the tender grass and underwood destroyed; the surface strewed with large limbs of trees, broken down by the weight of the birds collecting one above another; and the trees themselves, for thousands of acres, killed as completely as if girdled with an axe. The marks of their desolation remain for many years on the spot; and numerous places could be pointed out where, for several years after, scarcely a single vegetable made its appearance. When these roosts are first discovered, the inhabitants, from considerable distances, visit them in the night with guns, clubs, long poles, pots of sulphur, and various other engines of destruction. In a few hours they fill many sacks and load horses with them. By the Indians a pigeon-roost or breeding-place is considered an important source of national profit and dependence for that season, and all their active ingenuity is exercised on the occasion. The breeding-place differs from the former in its greater extent. In the western countries, namely, the states of Ohio, Kentucky, and Indiana, these are generally in back woods, and often extend in nearly a straight line across the country for a great way. Not far from Shelbyville, in the state of Kentucky, about five years ago, there was one of these breeding-places, which stretched through the woods in nearly a north and south direction, was several miles in breadth, and was said to be upwards of forty miles in extent. In this tract almost every tree was furnished with nests wherever the branches could accommodate them. The pigeons made their first appearance there about the 10th of April, and left it altogether with their young before the 25th of May. As soon as the young were fully grown, and before they left the nests, numerous parties of the inhabitants from all parts of the adjacent country came with waggons, axes, beds, cooking-utensils, many of them accompanied by the greater part of their families, and encamped for several days at this immense nursery. Several of them informed me that the noise was so great as to terrify their horses, and that it was difficult for one person to hear another speak without bawling in his ear. The ground was strewed with broken limbs of trees, eggs, and young squab pigeons, which had been precipitated from above, and on which herds of hogs were fattening. Hawks, buzzards, and eagles were sailing about in great numbers, and seizing the squabs from the nests at pleasure, while, from twenty feet upwards to the top of the trees, the view through the woods presented a perpetual tumult of crowding and fluttering multitudes of pigeons, their wings roaring like thunder, mingled with the frequent crash of falling timber; for now the axemen were at work, cutting down those trees that seemed to be most crowded with nests, and contrived to fell them in such a manner, that in their descent they might bring down several others; by which means the falling of one large tree sometimes produced 200 squabs, little inferior in size to the old ones, and almost one heap of fat. On some single trees upwards of 100 nests were found, each containing one squab only; a circumstance in the history of this bird not generally known to naturalists. It was dangerous to walk under these flying and fluttering millions, from the frequent fall of large branches, broken down by the weight of the multitudes above, and which in their descent often destroyed numbers of the birds themselves; while the clothes of those engaged in traversing the woods were completely covered with the excrements of the pigeons.

"These circumstances were related to me by many of the most respectable part of the community in that quarter, and were confirmed in part by what I myself witnessed. I passed for several miles through this same breeding-place, where every tree was spotted with nests, the remains of those above described. In many instances I counted upwards of ninety nests on a single tree; but the pigeons had abandoned this place for another, sixty or eighty miles off, towards Green River, where they were said at that time to be equally numerous. From the great numbers that were constantly passing over our heads to or from that quarter, I had no doubt of the truth of this statement. The mast had been chiefly consumed in Kentucky; and the pigeons, every morning a little before sunrise, set out for the Indiana territory, the nearest part of which was about sixty miles distant. Many of these returned before ten o'clock, and the great body generally appeared on their return a little after noon. I had left the public road to visit the remains of the breeding-place near Shelbyville, and was traversing the woods with my gun, on my way to Frankfort, when about ten o'clock the pigeons which I had observed flying the greater part of the morning northerly, began to return in such immense numbers as I never before had witnessed. Coming to an opening by the side of a creek called the Benson, where I had a more uninterrupted view, I was astonished at their appearance: they were flying with great steadiness and rapidity, at a height beyond gunshot, in several strata deep, and so close together that, could shot have reached them, one discharge could not have failed of bringing down several individuals. From right to left, as far as the eye could reach, the breadth of this vast procession extended, seeming everywhere equally crowded. Curious to determine how long this appearance would continue, I took out my watch to note the time, and sat down to observe them. It was then half-past one; I sat for more than an hour, but instead of a diminution of this prodigious procession, it seemed rather to increase, both in numbers and rapidity; and anxious to reach Frankfort before night I rose and went on. About four o'clock in the afternoon I crossed Kentucky River, at the town of Frankfort, at which time the living torrent above my head seemed as numerous and as extensive as ever. Long after this I observed them in large bodies that continued to pass for six or eight minutes, and these again were followed by other detached bodies, all moving in the same south-east direction, till after six o'clock in the evening. The great breadth of front which this mighty multitude preserved would seem to intimate a corresponding breadth of their breeding-place, which, by several gentlemen who had lately passed through part of it, was stated to me at several miles."

Wilson then enters into a rough calculation of the numbers of this mass, and he comes to the conclusion that its whole length was 240 miles, and that the numbers composing it amounted to 2,230,272,000 pigeons, observing that this is probably far below the actual amount. He adds, that allowing each pigeon to consume half a pint of food daily, the whole quantity would equal 17,424,000 bushels daily. Mr. Audubon confirms Wilson in every point, excepting that he very properly corrects that part of the narrative which would lead to the conclusion that a single young one only is hatched each time. The latter observes that the bird lays two eggs of a pure white, and that each brood generally consists of a male and female.

Description.—Wings long and acuminate, having the second quill-feather exceeding the others in length. The tail is greatly cuneiform or graduated, and consists of twelve tapering feathers. Bill black, and like that of the turtle. Legs purplish-red, short, and strong. Iris bright orange-red, the naked orbit purplish-red. Head and cheeks pale bluish-gray. Fore-neck, breast, and sides brownish-red, with a purplish tinge. Abdomen and vent white. Lower part and sides of neck purplish-crimson, reflecting tints of emerald green and gold. Upper plumage deep bluish-gray, some of the scapulars and wing-coverts spotted with black. Greater coverts gray, tipped with white. Quills blackish-gray, their exterior webs bluish-gray. Tail with the two middle feathers black, the other five on each side gray at the base, with a black bar on the interior arch, and passing into white towards the extremities.

The female is rather smaller, and has the colours of her plumage much duller than those of the male, though the distribution is the same. (Selby.)

The Passenger Pigeon inhabits the North American continent, between the 20th and 62nd degrees of north latitude. Mr. Eyton has figured one as a visitant to our shores, on the authority of Dr. Fleming, who, in his 'History of British Animals,' says that one was shot in the parish of Mouymeal, Fifeshire, on the 31st December, 1825. Mr.

Yarrell also records the capture of another specimen at Royston, in Cambridgeshire.

Mr. Selby refers provisionally *Columba Capensis*, Auct., *C. Macquarrii*, Lesson, and *C. venusta*, Temm., to his group of *Ectopistinæ*, and thinks that by these and some other nearly allied forms a passage to the next group, *Peristerinæ*, the Ground-Doves, is effected.

Family *Peristerinæ* (Selby).—Distinguished from the preceding groups by their terrene habits, and their evident approach in many points to the more typical *Rasores*, or Gallinaceous Birds. In these the bill is rather slender, frequently sub-emarginate, and the tip of the upper mandible gently deflected; the wings are generally short and rounded, and in many instances concave, as in the partridge, grouse, &c. The legs are considerably longer than in the typical pigeons, the tarsus usually exceeding the middle toe in length, and the feet better adapted for walking than grasping; the claws are obtuse and slightly arched. The hallux is shorter, and its relative position different from that of the arboreal species. Their plumage is plainer and more uniform in tint than that of some of the preceding groups, though it is still brilliant in those species which connect them with other forms. They live almost entirely upon the ground, and many of the species run with great celerity, on which account they have been called Partridge Pigeons. Their flight, which is usually low, is effected with greater exertion than that of the pigeons, and is never long sustained. (Selby.)

Mr. Selby observes that this division contains a great number of species, and is of opinion that when better investigated it will be found divisible into a variety of minor groups or genera. He places under it *Phaps*, *Chamæpelia*, and *Peristera*. This group is distinguished by a longer bill, very faintly emarginate, and by its tarsi, which are moderately long and naked, with the frontal scales divided into two series, and the sides and hinder part reticulated with minute scales. Another group, he adds, seems indicated by certain Asiatic species, conspicuous for the rich metallic green of the plumage of their backs, resembling therein some of the *Ptilinopinæ*. The tarsi of these are destitute of scales, except a few indistinct ones in front, just above the toes. The bill is rather long, and destitute of a notch. They live mostly on the ground, but their flight is powerful. Mr. Selby takes *Columba superciliosa* of Wagler as the type of this last-mentioned group.

Phaps (Selby).—Bill moderately long, rather slender; upper mandible gently deflected at the tip, and with the indication of a notch or emargination. Wings of mean length; second and third feathers longest, and nearly equal. Tail slightly rounded. Legs—tarsi as long as the middle toe, the front covered with a double row of scales, sides and back reticulated with small hexagonal scales. Hind toe short; inner toe exceeding the outer in length. Claws blunt, slightly arched. Type, *Columba chalcoptera*, Latham. *C. elegans*, Temm.; and *C. picata*, Wagler, belong to this group. (Selby.)

P. chalcoptera. It is the *C. chalcoptera*, Latham; the *C. Lumachelle* of Temminck; Bronze-Winged Ground-Dove.

Bronze-Winged Ground-Dove (*Phaps chalcoptera*).

Size about that of *C. Œnas*. Total length about 15 inches. Bill, from edges of the gape, hardly an inch; black anteriorly; reddish near the base. Forehead, stripe below the eyes, and throat, white; crown brown, tinged with reddish, filleted with dusky red; cheeks and sides of neck bluish-gray; bottom of neck in front and breast purplish-gray. Belly and vent gray, with a pale purple tinge. Back, scapulars, rump, and upper tail-coverts, brown tinged with greenish in some lights, the border of each feather paler. Wing-covers bluish-gray, but the outer webs of every feather have a large ovate spot, producing various tints of metallic brilliancy according to the direction of the light. Quills brown above, with the inner surface of the webs, the axillary feathers, and under wing-coverts bordered rather deeply with pale orange-red. Tail slightly rounded, bluish-gray, with a black band. Legs red; two rows of scales in front, the sides reticulated.

It is an inhabitant of Australia and islands in the Pacific; in the neighbourhood of Sydney from September till February.

It haunts dry and sandy places, where it is generally seen on the ground, and occasionally perched upon the low branches of shrubs. Nest inartificial, in holes of low trees or decayed trunks near the ground, sometimes on it. Eggs two, white. These birds go in pairs generally; their cooing is loud, and has been compared, when heard at a distance, to the lowing of a cow.

Chamæpelia (Swainson).—Bill slender, entire. Wings rounded, the first quill short, third, fourth, and fifth nearly equal and longest; the webs on both sides slightly emarginate. Tail rounded. Feet rather short; the sides of the tarsi feathered. Types, *Columba passerina*, Linn.; *C. squamosa*, Temm. (Swainson).

C. Talpicoti. It is the *Columba Talpicoti* of Temminck, the species which Mr. Selby considers to be the type. Length 6¼ inches, adult male; forehead, crown, and nape of neck, ash-gray; cheeks and throat pinkish-white; upper plumage entirely brownish-orange, with the exception of a few transverse streaks of black upon the exterior webs of some of the wing-coverts nearest the body; under plumage deep vinaceous-red; axillary feathers and part of under wing-coverts black; tail with the two middle feathers brownish-orange, the remainder brownish-black, with reddish-brown tips, moderately curved; bill and orbits bluish-gray; legs and toes pale red, the outer side of the tarsus with a row of small feathers down the line of junction between the acrotarsia and paratarsia; quills broad, the fourth with a large projecting notch towards the middle of the inner web. The female has the crown of the head of a sordid gray; the upper plumage of a wood-brown, tinged with red; the scapular and wing-coverts marked as on the male; under plumage dirty gray, tinged with pale purplish-red. (Selby.)

Chamæpelia Talpicoti.

This bird inhabits Brazil, Paraguay, and other districts of South America. It haunts open grounds near woods, where it roosts and breeds upon the underwood, but never far from the ground, where it is active, and feeds upon the smaller cerealia, berries, &c. Generally observed in pairs, sometimes in families of four or six, never in large flocks. Does not fly from the face of man, but affects the confines of houses and farm-yards. Easily kept and propagated in aviaries.

Peristera (Swainson).—Bill slender, sub-emarginate. Wings rounded, the first quill short and abruptly attenuated, second and fifth equal, third and fourth equal and longest. Tail rounded. Feet strong, naked, somewhat lengthened; anterior scales of the tarsi imbricate, lateral scales none. Type, *Columba cinerea*, Temm. (Swainson).

P. tympanistria. It is the *Columba tympanistria* of Temminck. Length about 9 inches; upper plumage brown, slightly tinged with gray on the neck; large spots of shining dark green on the outer webs of three or four of the greater wing-coverts; middle tail-feathers brown; the two exterior on each side gray, with a broad black bar near the tip; inner webs of greater quills deep brown; forehead, streak over the eye, and under plumage, pure white; under wing-coverts and sides pale orange-brown; under tail-coverts brown; bill and legs gray, the latter with a reddish tinge.

It inhabits South Africa, where it is said to haunt woods. The species does not seem to be common.

Geophilus (Selby).—Mr. Selby, speaking of *Columba cyanocephala*, Wagler, *Turtur Jamaicensis*, Brisson; *Columba carunculata*, Wagler; and *Columba Nicobarica*, Latham, *Columba Gallus*, Wagler, says—

Peristera tympanistria.

"Whether they will form a separate division, or the three first will enter among the *Peristerinæ*, and the *Lophyrus* alone remain a representative of another group, we are unable to determine, not possessing sufficient materials to institute so strict an analysis as is necessary, or to trace out with precision the direct affinities of those species, and the situation they hold in respect to the other groups of the *Columbidæ*, as well as those of the adjoining families. The three first we have provisionally included in the genus *Geophilus*. In their form and habits they approach still nearer to the typical gallinaceous birds than the species we have just been describing. Their tarsi are long, and covered with hexagonal scales; their tail short, and rather pendent; their wings concave, short, and rounded; and their body, as compared with the typical pigeons, thick and heavy. A striking departure from the general economy of the *Columbidæ* is further observed in their mode of propagation, the number of the eggs they lay each hatching not being confined to two, as is seen to prevail in the groups already described, but extending to eight or ten, which are incubated upon the ground, and the young, like those of the true gallinaceous birds, are produced from the egg in such a state as to be able immediately to follow the parent, which broods over and attends them like the partridge or domestic fowl. They live entirely upon the ground, except during the hours of repose, when they sometimes retire to bushes, or the low branches of trees. They walk and run with great quickness, like the *Gallinæ*, and in fact appear to be the forms which immediately connect this family with the *Pavonidæ* and *Tetraonidæ*. Although for the present we have placed the first three under the same generic head, yet from their distinct geographical distribution, and the difference observed in the bill of the first, it is more than probable that a further division will be required."

G. carunculatus. It is the *Columba carunculata* of Temminck; the Colombe Galline of Le Vaillant. Size about that of the Common Turtle, but with the body stouter and more rounded. Base of the bill and forehead covered with a naked red wattle; another wattle of the same hue depends from the chin, and branches of it extend upwards towards the ears. Plumage of head, cheeks, neck, and breast, purplish-gray; back, scapulars, and wing-coverts, pale gray; feathers bordered with white. Belly, upper and under tail-coverts, flanks, and under wing-coverts, white. Tail short, rounded, deep ruddy-brown, except the outer feather on each side; these have the outer web white. Legs covered with hexagonal scales, purplish-red. Iris with a double circle, yellow and red. The female has no wattle, and her colours are less pure. (Le Vaillant.)

It inhabits South Africa, where it was discovered in the Great Namaqua country by Le Vaillant, who gives the following account of its habits and affinities:—"To the pigeons its affinity is shown by the form of the bill and the plumage; while it differs from them in the pendent wattle, elongated tarsi, rounder body, less graceful form, tail, which it carries hanging down like that of a partridge, and rounded wings; points which bring it near to the *Gallinæ*." A passage is thus formed by it, in his opinion, between those birds and the pigeons. The nest, composed of twigs and the dried stems of grasses, is formed in some slight hollow of the ground, and there the female lays six or eight reddish-white eggs, which are incubated by both the parents. The young are hatched clothed with down of a reddish-gray, run immediately and follow their parents, which keep them together by a peculiar oft-repeated cry, and brood over them with their wings. Their first food consists of the larvæ of ants, dead insects, and worms, which the parents point out to them. When strong enough to find their own food, they live on grain of different sorts, berries insects, &c., and keep together in coveys, like the partridge and other *Tetraonidæ*, till the pairing-time.

Geophilus carunculatus.

If the wattles of the last-named species recall to the observer the same parts so highly developed in the gallinaceous birds, the species which we next present will remind him of the hackles which ornament the *Gallinæ*.

G. Nicobaricus. It is the *Columba Nicobarica* of Latham, the *C. Gallus* of Wagler. Length hardly 15 inches; bill slender, about 1¼ inch long, tip but little bent downwards; the tail pure white, the quills deep blackish-blue, with varying tints of green; all the rest of the plumage rich metallic green, shooting, according to the light, into the variegated tints of golden-green, bronze, bright copper-colour, and deep purplish-red; neck-feathers long, narrow, and pointed, like those of the domestic cock; barbules towards the tip silky and distinct; tail short, pendent, nearly square; wings, when closed, reaching nearly to the termination of tail; legs strong, moderately long, black, covered with hexagonal scales; nails yellow, gently curved, blunt. Upon the base of the upper mandible of the male a round fleshy tubercle (probably apparent in the breeding season only). The female resembles the male in colour, but her neck-feathers are not so long, and she has no tubercle.

Geophilus Nicobaricus.

It inhabits the isles of Nicobar, Java, Sumatra, and many of the Moluccas. Authors differ about its habits, some asserting that its nest is placed on the ground, and that the female lays several eggs, the young running as soon as hatched; but Mr. Bennett, who saw them in Mr. Beale's aviary at Macao, says that they were usually seen perched upon the trees, even upon the loftiest branches, and adds, that they build their rude nests and rear their young upon trees, similar to all the pigeon tribe.

Lophyrus (Vieillot).—Bill moderate, rather slender, and slightly gibbous towards the tip; upper mandible channeled (sillonnée) on the sides, inclined towards the point; nostrils situated in a groove; wings rounded. (Vieillot.)

L. coronatus. It is the *Columba coronata* of Latham; *Phasianus cristatus Indicus*, Brisson; *Columbi Hocco*, Le Vaill.; Colombe Galline Goura, Temm.; Great Crowned Pigeon, Edw. A species surpassing in size all the other *Columbidæ*. Total length from 27 to 28 inches; bill two inches long, black, tips of mandibles thickened, that of the upper one somewhat deflected; head with a large elevated semicircular compressed crest of narrow straight feathers, with decomposed or rather disunited silky barbules, always erect; crest and body below grayish-blue; feathers of back, scapulars, and smaller wing-coverts, black at the base, rich purple-brown at the tips; greater coverts same colour, but centrally barred with white, forming a single transverse band across the wings when closed; quills and tail deep gray, the latter terminated with grayish-blue; legs gray; tarsi 3¼ inches in length, covered with rounded scales not closely set, with a white border of skin round each; toes strong and somewhat short, scales placed as in the *Columbinæ*.

Great Crowned Pigeon (*Lophyrus coronatus*).

This bird is found in many of the islands of the great Indian group. Not rare in Java and Banda, abundant in New Guinea and in most of the Moluccas. Nest built in trees; eggs two; cooing of the male hoarse, accompanied by a noise somewhat like that of a turkey-cock when strutting. Food—berries, seed, grain, &c. Flavour of the flesh said to be excellent.

"In this magnificent and beautiful bird," says Mr. Selby, "we observe a combination of form different from that of the ground-pigeons so lately described; for, instead of the marked affinity to the typical rasorial families, the *Pavonidæ* and *Tetraonidæ*, so decidedly exhibited by these species, both in their mode of life and in their deviation from the usual Columbine figure, we have, in the present instance, an approximation of structure much nearer that of some of the *Cracidæ*, another tribe of birds which constitutes an aberrant family of the Rasorial Order; and it is on this account we think that this bird cannot well be placed in the same division with the ground-doves, but must constitute the type of a separate group."

Fossil Columbidæ.—Dr. Buckland enumerates the bones of the pigeon among the remains in the cave at Kirkdale, and figures a bone which he says approaches closely to the Spanish runt; but Professor Owen, in his 'British Fossil Mammals and Birds,' is silent on this subject.

COLUMBINE. [AQUILEGIA.]

COLUMBITE, a Mineral into the composition of which the metal Columbium enters. Columbium on its first discovery was also called by chemists Tantalum, and this mineral has also been called *Tantalite*.

Columbite occurs in rectangular prisms, more or less modified, also massive. It is of an iron-black or brownish-black colour, often with a characteristic iridescence on a surface of fracture; the streak dark brown, slightly reddish; lustre submetallic, shining; opaque; brittle. The hardness is 5 to 6; the specific gravity 5·3 to 6·4.

According to Dana the composition of an American specimen was as follows:—

Columbic with Niobic Acid	80·1
Protoxide of Iron	12·6
Protoxide of Manganese	6·0
Oxide of Tin	·1
Oxides of Copper and Lead	·4

Bavarian specimens contain Pelopic acid, which, according to Rose, accounts for their high specific gravity, which ranges from 5·7 to 6·4.

This mineral is infusible alone before the blowpipe, but on mixture with borax in fine powder it fuses slowly but perfectly, forming a dark green glass, which indicates the presence of iron.

Columbite is found in granite at Bodenmais in Bavaria, also in Bohemia. It occurs in the United States in feldspathic or albitic rocks, at Middletown and Haddam, Connecticut, at Chesterfield and Beverley, Massachusetts, and at Acworth, New Hampshire. *Ferro-tantalite* is a Columbate of Iron.

(Dana, *Mineralogy.*)

COLUME'LLA, the central part or axis in the theca of a moss, around which the spores are arranged, without having any definite connection with it. Also the axis of any kind of fruit when separate from the carpels: in the latter case it is a hardened state of the growing point.

COLUMELLIACEÆ, a natural order of Exogenous Plants with epipetalous stamens, sinuous anthers bursting longitudinally, and

Columellia oblonga.

1, a flower seen from above; 2, the ovary, style, and stigma; 3, the half-ripe fruit; 4, the fruit opening, with the calyx adhering; 5, the pericarp separated from the calyx; 6, valves of the pericarp; 7, one valve and seeds.

unsymmetrical flowers. They are evergreen shrubs or trees. The leaves opposite, without stipules, entire or serrated; the flowers yellow and terminal; calyx superior, 5-parted; corolla rotate, 5-8-parted, with an imbricated æstivation; stamens 2, inserted in the throat, alternate with the segments of the corolla; anthers roundish, 3-lobed, bursting externally, each consisting of three pairs of narrow somewhat sinuous cells, which open longitudinally, and which are placed upon a solid fleshy connective. The affinities of this order are very doubtful. Professor Don, who first noticed the order, places it near the Jasmines. It differs however materially from them, and may almost be described as a form of monopetalous *Onagraceæ*. Dr. Lindley, in this uncertainty, leaves it by the side of *Berberaceæ* and *Cinchonaceæ*; to either of which, and especially to the latter, it may be compared. The species hitherto discovered are from Mexico and Peru. They are not known to possess any useful properties.

COLUMNARIA. [MADREPHYLLLÆA.]

COLUMNEA, a genus of Plants belonging to the natural order *Gesneraceæ*. One of the species (*C. scandens*) is called by the French colonists Liane à Sirop, because its flowers secrete a large quantity of honey.

COLUMNI'FERÆ, an old name for Plants belonging to the natural order *Malvaceæ*. [MALVACEÆ.]

COLUTE'A, a Papilionaceous genus of Exogenous Plants, consisting of hardy shrubs, with pinnated leaves and inflated membranous pods, which explode when suddenly compressed, and which look like vegetable bladders, whence the common English name of Bladder-Senna. The species have yellow or yellow and red flowers of some beauty; and are all found in the South of Europe, in Palestine, and in the Himalaya Mountains.

COLY'MBIDÆ, a family of Swimming Birds (*Natatores*), having a smooth, straight, compressed, and pointed bill.

Willughby assigned the family a place in his fifth section ('Whole-Footed Birds, with Shorter Legs'), under the name of "Douckers or Loons, called in Latine *Colymbi*," and he divided them into "Cloven-Footed Douckers that have no Tails," the Grebes, and the "Whole-Footed Douckers with Tails," the true Divers. The following is Willughby's description 'of Douckers in general:'—"Douckers have narrow, straight, sharp-pointed bills, small heads, and also small wings; their legs situate backwards, near the tail, for quick swimming and easier diving; broad flat legs, by which note they are distinguished from all other kinds of birds; broad claws, like human nails. Of these Douckers there are two kinds; the first is of such as are cloven-footed, but fin-toed, having lateral membranes all along the sides of their toes, and that want the tail; the second is of those that are whole-footed and caudate, which do nearly approach to those birds we call *Tridactylæ*, that want the back toe. These are not without good reason called 'Douckers,' for that they dive much, and continue long under water, as soon as they are up dropping down again."

Ray, in his 'Synopsis,' arranges the Cloven-Footed and Whole-Footed *Colymbi*, Grebes, and Divers, under his 'Palmipedes Tetradactylæ digito postico soluto, et primò rostro recto angusto acuto, Brachypteræ et Urinatrices, *Colymbi* dictæ.' He also includes the genus *Mergulus*. [AUK.]

Linnæus placed both the Divers, properly so called, and the Grebes under his genus *Colymbus*, which stands in his system under the order *Anseres*, between the genera *Phaëton* (Tropic Birds), and *Larus* (Gulls).

Pennant followed Brisson in separating the Grebes from the Divers. The first he placed next to the Coots, and immediately before the Avosets; and the Divers between the Guillemots and the Gulls.

Under the term 'Plongeurs, ou Brachyptères,' Cuvier arranges those *Palmipedes*, "a part of which have some relation to the Water-Hens. The legs placed more backward than in any of the other birds, render walking a difficult operation, and oblige them, when on land, to keep themselves in a vertical position. As the greater part of them are, besides, bad flyers, inasmuch as some of them cannot fly at all on account of the shortness of their wings, they may be regarded as almost exclusively attached to the surface of the waters. In accordance with this destination their plumage is more close-set, and sometimes it even offers a smooth surface and silvery hue. They swim under the water, aiding themselves with their wings, nearly as if they were fins. Their gizzard is sufficiently muscular, their cæca are moderate, and they have each a peculiar muscle on each side of their lower larynx." The following are the genera comprehended under this family by Cuvier:—the Grebes, Brisson (*Podiceps*, Latham; *Colymbus*, Brisson and Illiger); the Divers (Plongeons), properly so called (*Mergus*, Brisson; *Colymbus*, Latham; *Eudytes*, Illiger); the Guillemots (*Uria*, Brisson and Illiger); the Auks (Pingouins), *Alca* of Linnæus; the Penguins (Manchots), *Aptenodytes* of Forster, consisting of the sub-genera *Aptenodytes*, Cuvier; *Catarrhactes*, Brisson; and *Spheniscus*, Brisson.

Temminck places the Grebes (*Podiceps*) next to the *Phalaropes*, at the end of his fourteenth order, the *Pinnatipedes*, or Fin-Footed Birds; and the Divers (*Colymbus*, Latham) between the Pelicans and the Guillemots in his fifteenth order, the *Palmipedes*.

Mr. Vigors makes his fifth order of birds (*Natatores*) comprise the following families:—

Anatidæ, Leach.
Colymbidæ, Leach.
Alcadæ.
Pelecanidæ, Leach.
Laridæ, Leach.

Or, with reference to the typical groups—

Normal Group.

With short wings, which are sparingly feathered, and with feet placed behind the equipoise of the body . .	*Colymbidæ*. *Alcadæ*.

Aberrant Group.

With longer and well-feathered wings, and feet especially placed within the equipoise of the body . .	*Pelecanidæ*. *Laridæ*. *Anatidæ*.

M. Lesson, in his 'Manuel,' makes the *Colymbidæ* (Plongeurs, ou Brachyptères, Cuvier; *Urinatores*, Vieillot) the first family of the sixth order of birds, Les Palmipèdes (*Natatores* of Illiger and Vieillot); and the family comprises the genera *Podiceps*, Latham; *Colymbus* (part), Linnæus; and *Cephus*, Cuvier.

The Prince of Canino places *Podiceps* under his order *Anseres* in the family *Lobipedes*, and *Colymbus* under the same order in his family *Pygopodes*.

In the 'Fauna Boreali-Americana,' *Podiceps* is placed at the head of the order *Natatores*, and is immediately succeeded by *Sterna* (the Terns): the position of *Colymbus* is between *Pelecanus* and *Uria*, which last-mentioned genus concludes the order.

Podiceps.—Bill longer than the head, robust, slightly compressed or nearly cylindrical, subulated, straight, entire, pointed; upper mandible straight, or hooked at the point; nostrils oblong, half-closed. Wings short, the first three quills of equal length and longest. Tail none. Toes bordered with large fimbriations; hallux pinnated.

Head and Foot of the male Eared Grebe; summer plumage. The head from Mr. Gould's 'British Birds;' the foot from a specimen in the Museum of the Zoological Society.

The species of *Podiceps* are called Grebes. They haunt the sea as well as the rivers, are excellent swimmers, and dive frequently, as all who have watched the Dabchick or Little Grebe (*Podiceps minor*), and have been amused by its quickly-repeated plungings, well know. They feed on small fishes, frogs, crustaceans, and insects, and their nests, formed of a large quantity of grass, &c., are generally placed among reeds and carices, and rise and fall with the water.

The geographical distribution of this genus is very wide. Five European species are enumerated, and the foreign species are very numerous. The form seems capable of adaptation to great varieties of climate. In the 'Tables' published in the 'Introduction to Fauna Boreali-Americana,' we find *P. cornutus* and *P. Carolinensis* among the birds which merely winter in Pennsylvania, and migrate in summer to rear their young in the Fur Countries; and *P. cristatus*, *P. rubricollis*, and *P. cornutus* in the list of species common to the Old World and to the Fur Countries. Sabine gives a description of a mature individual of *P. rubricollis* killed at Great Slave Lake, and of a specimen of *P. Carolinensis* killed at the same place, both in Sir John Franklin's first expedition and in May 1822; and Sir John Richardson notes *P. cristatus* as having been killed on the Saskatchewan, and *P. cornutus* at Great Slave Lake ('Fauna Boreali-Americana'). *P. Chilensis* and *P. Americanus* are natives of the warm parts of America; the first, as its name implies, having been found in the Bay of Concepçion, and the second on the Brazilian waters (Rio Grande and S. Paulo).

P. occipitalis (Lesson) may be taken as an example. This Grebe, according to M. Lesson, is remarkable for the delicate tints of its plumage, which is slate-gray (gris ardoisé) above and of a satiny white below. The cheeks and forehead are of a light gray; a bundle of loose plumes (plumes effilées) springs behind each eye, and is prolonged backwards and on the sides of the neck. A calotte of deep black rises from the occiput, and is prolonged on the posterior part of the neck half-way down it. The throat is of a pearled-gray, which becomes lighter, so that the front of the neck and the sides are of a pure white, as well as the rest of the lower part of the body. The back and wings are of a deeper slate-colour, and this tint, mingled however with white, prevails on the feathers of the rump. The tarsi, toes, and the considerably large membranes which fringe them, are greenish. The bill is short and black. The iris is of a most lively red, so brilliant as to call forth from Père Dom Pernetty, whose Petit Plongeon à Lunettes it is, the expression that "diamonds and rubies have nothing to offer equal to the fire of the eyes of a species of Plongeon which is frequently found on the edge of the sea." The total length of this Grebe is 11 inches and 2 or 3 lines; from the forehead to the point of the bill, 8 lines; tarsi, 17 lines; external toe, 2 inches.

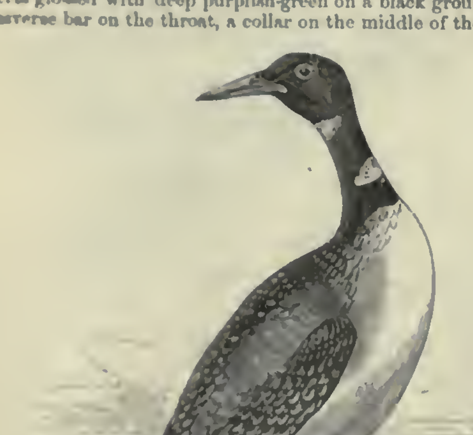
The British species of this genus given by Yarrell in his 'British Birds,' are—*P. cristatus*, the Great-Crested or Great-Tippet Grebe; *P. rubricollis*, the Red-Necked Grebe; *P. cornutus*, the Sclavonian, Dusky, or Horned Grebe; *P. auritus*, the Eared Grebe; and *P. minor*, the Little or Black-Chin Grebe, Dabchick, and Didapper.

Colymbus.—It is the *Mergus* of Brisson; *Urinator*, Lacépède; and *Eudytes*, Illiger. Bill moderate, strong, straight, very much pointed, compressed; nostrils concave, half closed. Wings short; the first quill the longest. Tail short, rounded. Three front toes very long, entirely palmated; hind toe bordered with a small supple membrane.

The Divers bear a close resemblance to the Grebes, from which they differ but little, excepting in their palmated feet. On the water they are at their ease: on land, they, as well as the Grebes, are awkward and beset with difficulties in their locomotion.

They principally inhabit the northern latitudes, where they nestle in the wildest and most desert spots. In the 'Tables' in 'Fauna Boreali-Americana,' we find *C. glacialis* and *C. septentrionalis* in the list of species which merely winter in Pennsylvania and migrate in summer to rear their young in the Fur Countries, and *C. septentrionalis* in the list of birds (migratory) detected on the North Georgian Islands and adjoining seas (lat. 73° to 75° north), on Sir Edward Parry's first voyage. *C. glacialis* and *C. septentrionalis* occur in Sabine's list of Greenland Birds; and *C. glacialus*, *C. arcticus*, and *C. septentrionalis* in Sir John Richardson's list of species common to the Old World and to the Fur Countries.

C. glacialis, the Great Northern Diver. Head, neck, and upper tail-coverts glossed with deep purplish-green on a black ground. A short transverse bar on the throat, a collar on the middle of the neck, interrupted above and below, and the shoulders white, broadly striped on the shafts with black. Whole upper plumage, wings, sides of the breast, flanks, and under tail-coverts, black; all, except the quills and tail, marked with a pair of white spots near the tip of each feather: the spots form rows, and are large and quadrangular on the scapulars and interscapulars, round and smaller elsewhere; smallest on the rump. Under plumage and inner wing-coverts white, the axillaries striped down their middles with black. Irides brown. Bill compressed, strong, tapering; its rictus quite straight; its contour very slightly arched above; lower mandible channeled beneath, appearing deepest in the middle; its gonys sloping upwards to the point; margins of both mandibles, but particularly of the lower one, inflected. Inner wing-coverts very long. Tail, of twenty feathers, much rounded. Total length 36 inches; extent of wing 48 inches. Sir John Richardson, whose description this is, observes, that specimens in mature plumage vary considerably in total length, upwards of an inch in length of wing, and more than half an inch in the length of the tarsus.



Great Northern Diver (*Colymbus glacialis*).

The young of the year differ considerably from the old birds. The head of the young, the occiput, and the whole posterior part of the neck are of an ashy-brown; on the cheeks are small ashy and white points; throat, front of the neck, and other lower parts, pure white; feathers of the back, of the wings, of the rump and flanks, of a very deep brown in the middle, bordered and terminated by bluish-ash; upper mandible ashy-gray, lower mandible whitish; iris brown; feet externally deep brown; internally, as well as the membranes, whitish. In this state Temminck says that the bird is the *Colymbus Immer*, (Gmelin, 'Syst. Lath. Ind.'); Le Grand Plongeon of Buffon (but the plate enl. 914 represents a young individual of *Colymbus arcticus*); Mergo Maggiore o Smergo ('Stor. deg. Uec.'), with a good figure. He thinks that the Imber Taucher of Bechstein ('Naturg. Deut.') is probably a young of this species on account of its large dimensions, and remarks that under the name of *C. Immer* the young of this species are often confounded with those of *C. arcticus*.

At the age of a year, according to the same author, the individuals of both sexes show a transverse blackish-brown band towards the middle of the neck, about an inch in length, forming a kind of collar; the feathers of the back become of a blackish tint, and the small white blotches begin to appear. In this state it is the Grand Plongeon of Brisson (vol. vi. p. 105, pl. 10, f. 1), a very exact figure.

At the age of two years the collar is more defined: this part, the head, and the neck are varied with brown and greenish-black feathers; the numerous blotches on the back and wings become more prevalent, and the band under the throat, and the nuchal collar also, are marked with longitudinal brown and white lines.

At the age of three years the plumage is perfect.

According to Montagu, *Colymbus glacialis* is the *Colymbus maximus caudatus* of Ray; *Mergus major nævius* and *Mergus nævius* of Brisson; L'Imbrim of Buffon; Greatest Speckled Diver or Loon of Willughby; and Northern Diver of Pennant ('Brit. Zool.'): and the female is *Colymbus Immer* of Linnæus; *Colymbus maximus Gesneri* of Ray; *Mergus major* of Brisson; Le Grand Plongeon of Buffon; Ember Goose of Sibbald; and Imber Diver of the British Zoology. It is the *Colymbus torquatus* of Brunnich; the Schwarzhalsiger See-Taucher, Eis-Taucher, Grosse Halb-Ente, and Meer-Noering, of the Germans; Brusen of the Norwegians; Turlik of the Greenlanders; Eithinnew-Moqua of the Cree Indians; Talkyeh of the Chipewyans; Kagloolek of the Esquimaux; Inland Loon of the Hudson's Bay residents; and Trochydd Mawr of the Welsh: it is provincially called by the British Gunner and Greater Doucker.

Fish is the principal food of this species, and the herring in particular; the fry of fish, crustaceans, and marine vegetables. It nestles in small islands and on the banks of fresh waters, and the female lays two eggs of an Isabella-white, marked with very large and with small spots of a purplish-ash. Sir John Richardson gives the following description of its manners:—"Though this handsome bird is generally described as an inhabitant of the ocean, we seldom observed it either in the Arctic Sea or Hudson's Bay; but it abounds in all the interior lakes, where it destroys vast quantities of fish. It is rarely seen on land, its limbs being ill fitted for walking, though admirably adapted to its aquatic habits. It can swim with great swiftness, and to a very considerable distance under the water; and when it comes to the surface, it seldom exposes more than the neck. It takes wing with difficulty, flies heavily, though swiftly, and frequently in a circle round those who intrude on its haunts. Its loud and very melancholy cry, like the howling of the wolf, and at times like the distant scream of a man in distress, is said to portend rain. Its flesh is dark, tough, and unpalatable. We caught several of these birds in the fishing-nets, in which they had entangled themselves in the pursuit of fish." The species is sometimes taken even in the south of England. Montagu mentions one which was kept in a pond for some months. In a few days it became extremely docile, would come to the call from one side of the pond to the other, and would take food from the hand. The bird had received an injury in the head, which had deprived one eye of its sight, and the other was a little impaired; but, notwithstanding, it could, by incessantly diving, discover all the fish that were thrown into the pond. When it could not get fish it would eat flesh; and when it quitted the water, it shoved its body along upon the ground like a seal, by jerks, rubbing the breast against the ground; and returned again to the water in a similar manner. In swimming and diving the legs only were used, and not the wings, and by their situation so far behind, and their little deviation from the line of the body, it is enabled to propel itself in the water with great velocity in a straight line, as well as turn with astonishing quickness. In the winter of 1813-14, according to Mr. Graves, during the intense frost, two fine individuals were taken alive in the Thames below Woolwich, and were kept in confinement for some months. They eagerly devoured most kinds of fish or offal. At the approach of spring they began to show great uneasiness in their confinement, though they had the range of an extensive piece of water, from whence they ultimately escaped in the month of April. The distance of the river from the pond in which they were confined was several hundred yards, but they made their escape; and two birds resembling them in colour were seen on the river in that neighbourhood for several days after they were missed; and though repeatedly shot at, they escaped by diving.

They are found in the arctic seas of the New and Old World; very abundant in the Hebrides, Norway, Sweden, and Russia; accidental visiters along the coasts of the ocean. The young in winter are very rare on the lakes of the interior, in Germany, France, and Switzerland; the old birds are never seen there. (Temminck.) It is a rather rare visitant to these islands, especially to the southward.

C. arcticus, the Black-Throated Diver, the Lesser Imber, Plongeon à Gorge Noire of the French. In habits and appearance this bird is like the last. It is more rare in this country.

C. septentrionalis, the Red-Throated, or Speckled Diver, is the most common species in Great Britain.

Lesson arranges the genus *Cephus*, Mœhring, Cuvier (*Colymbus*, Linn.; *Uria*, Temm.; *Mergulus*, Ray, Vieillot), under the *Colymbidæ*, observing that it forms the passage from the Divers to the Auks. [Auk.]

COLYMBUS. [Colymbidæ.]

COLZA. [Brassica.]

COMARUM, a genus of Plants belonging to the natural order *Rosaceæ*. It has a concave 8-10-parted calyx in two rows, the five exterior sepals being smallest; 4-5 petals; the receptacle ultimately large, fleshy, spongy, and persistent; the style lateral near the summit of the nut, the seed ascending. There is but one species of this genus, *C. palustre*, Marsh Cinquefoil. It has an ascending stem, is about one foot high, has pinnate leaves, dark purple flowers, and numerous carpels seated on the dry spongy receptacle. This plant is a native of Great Britain. It is found in marshes and peaty bogs. In Scotland the fruit is called Cow-Berries. The roots dye wool of a dirty red colour, and possess a sufficient amount of tannin to render them available for making leather. In gardens it will grow in any moist soil, and may be increased by dividing at the root.

COMATULA, Lamarck (*Alecto*, Leach), a genus of Radiated Animals. Linnæus appears to have confounded the form with the other Star-Fishes; for it is only noticed by him as a species of his genus *Asterias*. Neither Gmelin nor Pennant disturbed this arrangement. M. de Fréminville ('Nouv. Bull. des Sciences') seems to be the first who formed a genus for it, under the name of *Antedon*. Leach characterised it generically under the name of *Alecto*. Lamarck makes it the first genus of his first family (Les Stellérides) of his order of Echinodermatous *Radiaria*, placing it immediately before *Euryale*. Cuvier arranges the genus under his Échinodermes Pédicellés; observing, that it is near to the division of the *Euryales* and *Comatulæ* that the *Encrinites* ought to have their position. Miller is of opinion that *Comatula* presents a conformity of structure with that of the Pentacrinite almost perfect in every essential part, excepting that the column is either wanting or reduced to a single plate; and M. de Blainville makes it come under his first section (Free Asterencrinideans) of his third family (Asterencrinideans) of his third order (Stelleredians) of his first class (Cirrhodermarians) of his first type (Actinozoarians) of Zoophytes.

The genus is thus characterised by M. de Blainville:—Body orbicular, depressed, membranous; protected above by an assemblage of calcareous pieces, of which one is medio-dorsal, with one or two rows of accessory articulated simple rays, and provided on its circumference with five great rays, deeply bifid and pinnated, commencing with three basilary pieces. Mouth rather anterior, isolated, membranous, at the bottom of a star formed by five bifurcated channels. A large pseudo-anal orifice at the fringed extremity of a visceral sac.

The following details of structure are given by the same author. The body of *Comatula* is almost entirely membranous below; above, on the contrary, it is protected by a sort of cupule, which is thick, and composed of calcareous pieces, articulated and held together by a very delicate and hardly distinct skin. This cupule is formed by a centro-dorsal part, in which two pieces placed one over the other enter. It is round the first that the auxiliary rays are articulated, and to the second the great rays are joined by means of their basilary part.

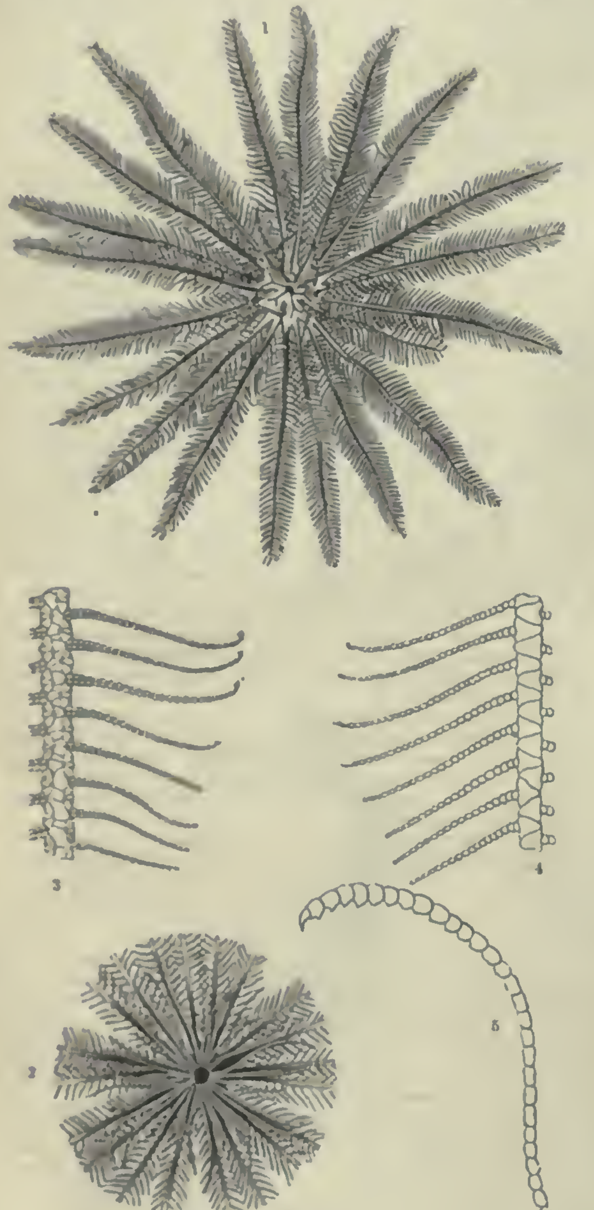
The auxiliary rays, whatever may be their number, for they may form one or two rows, are always simple; that is, they are composed of simple articulations joined end to end, of which the last is attenuated and curved into a hook. (*Fig. 5.*) They are never pinnated, and it would appear that they are not provided with any suckers.

The great rays enter by their base into the composition of the cupule or cell in which the visceral mass is contained. Each of them is formed by a simple basilary part, and another much more extended, divided, and pinnated. The basilary part is composed of three joints, a first articulated with the centro-dorsal piece, a second intermediate, and a third terminal, with which the two principal divisions of the rays are joined, and which on that account is shaped into an angle at its summit. The joints of this basilary part not only articulate with each other, but laterally they touch the corresponding parts of the two neighbouring rays. By such a disposition, becoming more and more complex, it is that the heads of *Encrinites* and the genera allied to them are formed. With regard to the pinnated or complex part of the ray, it is at first constantly double, that is, formed of two digitations, which are themselves often subdivided in a variable manner; so that sometimes the *Comatula* bears a resemblance to a great figure of a sun: each subdivision is composed of joints in general but little elongated, which augment but little in number in a given space in proportion as they approach towards the extremity. Their most remarkable points are, that they alternately differ a little in length, and that the longest carry, right and left, on their internal surface, compressed triangular pinnules nearly cirrhous at their extremity, and also composed of a great number of short articulations. The result is, that when the animal is dead the digitation resembles the leaves of the *Mimosæ*, because the pinnules in repose cling one to another like the folioles of sensitive plants throughout the length of the rachis when they are closed. But the principal character which distinguishes the great rays from the accessory ones is, that through the whole length of the axis and pinnules the buccal or labial channel, fleshy and provided with sucking cirrhi serving the animal to seize its prey, is continued. In following out these channelings (espèces de sillons), the number of which is in proportion to that of the digitations of the ray, we arrive, by means of a channel from each, and occupying its base, at the centre of a sort of star with thick fringed borders, and finally at the mouth, which is at the bottom. The star formed by the junction of the channels of the rays is not symmetrical, that is, its branches are very unequal; some, which we shall call the anterior ones, being shorter than the others, or posterior ones. The result is, that the mouth is not at the centre of the star, but much nearer one side than the other; it is difficult to be seen, which is not the case with another orifice which we shall presently discuss, and which M. Lamarck seems to have taken for it. The mouth is deeply buried in the star of the channelings, is round, unarmed, and leads immediately into the stomach. What is remarkable in this last is, that its parietes are thick, and especially that it is not simple. It is in fact full of lacunæ, or rather it forms a sort of cavernous tissue, enveloped on all sides by a yellow granulated matter of some volume, which must be the liver. The result of this disposition of stomach and liver is a considerable visceral mass, which occupies the excavated part of the calcareous cupule, and which is attenuated by degrees as it retires backwards, where it terminates in a soft and obtuse point. All this mass projects in the interior of a large cavity, of which it remains to speak. This cavity, entirely membranous—at least below, for above and on the sides it is doubled by the solid parts—surrounds the visceral mass, and detaches it from all the rest of the animal, except towards the mouth, where it is continued. The internal orifice M. de Blainville was unable to discover. It is perfectly smooth, but it is prolonged externally into a sort of bladder (vessie), the base of which is behind, and whose truncated summit is forward. This free summit passes even a little beyond the mouth as it advances below it. It is pierced by a large gaping orifice, provided with a circular row of tentaculiform papillæ.

In the 'Descriptive Catalogue of the Museum of the College of Surgeons' (Physiological Series, vol. i.), there is a notice regarding *Alecto glacialis* (No. 435, A), which imports that the alimentary canal is continued in a spiral direction from the sub-central opening at the convergence of the radiated canals to the opening at the extremity of the fleshy tube which projects forwards by the side of the mouth, forming a second distinct orifice or anus. Professor Owen at first followed Lamarck in considering this tubular orifice as the mouth; but after dissecting a specimen carefully, and considering the analogy of *Alecto* with the other *Asteriæ*, he regarded it as the superadded orifice, and the sessile orifice at the convergence of the canals or channels as the normal orifice, and consequently the mouth. He is of opinion that this tubular orifice cannot be the opening of the oviducts, because the ovaries are situated in membranous expansions on the inside of the pinnules of the rays, as has been described in another part of the 'Physiological Catalogue.' That the tubular cavity should be a locomotive organ he considers most improbable, to use no stronger term; indeed the animal is so well provided with moveable rays, that such an adaptation would be superfluous. Whether or not some respiratory actions are effected by the fleshy tube and receptacle is another question, requiring observation on the currents, &c., while the animal is living, for its solution.

Péron states that these *Radiata* suspend themselves by the small arms from fuci and polyparies, and in that position watch for their prey, which they entrap in their spreading arms.

Comatula rosacea, Link, Rosy Feather-Star. The whole animal is of a deep rose-colour dotted by brown ovaries and fringed by transparent cirrhi. Professor E. Forbes, in his 'History of British Star-Fishes,' says: —"The history of this creature is one of the little romances in which natural history abounds, one of those narrations which while believing we almost doubt, and yet while doubting we must believe, it being the only Crinoid animal at present inhabiting our seas, at one time so full of those beautiful and wonderful creatures, presenting points of great interest not to the zoologist only but also to the geologist." In the year 1823 Mr. J. V. Thompson discovered in the Bay of Cork a singular little pedunculated animal, which he called *Pentacrinus Europæus*, and which proved to be the young of the *Comatula*, and gave rise to much interest and discussion both at home and abroad, for it was the first animal of the Encrinite kind which had been seen in the seas of Europe, and the first recent *Encrinite* that had ever been examined by a competent observer in a living state. In 1836 Mr. Thompson published a memoir in the 'Edinburgh New Philosophical Journal,' maintaining the proposition that his *Pentacrinus Europæus* was only the young of *Comatula*; that the Feather-Star commenced life as an *Encrinite*, and thus as it were changed its nature from a pseudo-polype to a star-fish. He then compares the youngest *Comatula* he had met with, with the oldest *Pentacrinus*, and shows the gradual progression



1, *Comatula Adeonæ*, three-fourths of the natural size, lower side; 2, upper side of the same; 3, part of the under side of a ray magnified; 4, upper side; 5, one of the dorsal rays magnified, showing the hook or anchor. De Blainville.

of form during the development of the latter towards the adult state of the former. Since that time other naturalists have testified to this observation of Mr. J. V. Thompson; it is confirmed by Professor E. Forbes, Dr. Ball of Dublin, and the late Mr. W. Thompson of Belfast.

C. Adeonæ of Lamarck has the following characters:—10 pinnated, slender, penniform rays; pinnules lanceolate, complicatedly canaliculate below; 20 dorsal cirrhi.

It inhabits the seas of Australia, where Péron and Lesueur found it hooked on to an *Adeona*. It is small, delicate, with 10 very slender feathery rays, and only 3 inches in diameter. The pinnules are lanceolated, and folded in two, as it were, below, longitudinally.

The species of *Comatula* are widely spread. The Rosy Feather-Star is found on many parts of the British Coast. Two species are given as British in most works on zoology, *C. rosacea* and *C. barbata*. They are evidently the same animal of different ages or in different states of preservation: they are both identical with the *C. Mediterranea* of Lamarck. A Feather-Star is a very different animal when preserved in spirits with its expanded fins from what it appears when dried. In the Museum of the College of Surgeons there are two specimens from the Society Isles, one brought up from a depth of 226 fathoms, in 80° 26′ N. lat., 12° 30′ E. long. (H.M.S. Dorothea, Captain Buchan, R.N.); and the same species (*Alecto glacialis*) from 250 fathoms, 80° 26′ N. lat., 11° 32′ E. long. (H.M.S. Trent, Lieutenant Franklin, R.N.).

The species probably are tolerably numerous. Dr. Leach records three species, two in the British Museum, Lamarck eight, and De Blainville nine. Many of the species are of comparatively large size. [ECHINODERMATA.]

Fossil Comatulæ.

Goldfuss enumerates four species from Solenhofen (Oolitic group). There are none in any of the British strata.

COMBRETA'CEÆ, an order of Polypetalous Exogenous Plants, with 1-celled inferior fruit, the seeds of which are solitary or nearly so, and pendulous, the stamens definite in number, and the cotyledons convolute. It cannot be doubted that this order has a near relation to *Myrtaceæ* and especially to *Punica*. Dr. Lindley considers it to be in closer alliance with *Lauraceæ* and *Compositæ*.

Combretum coccineum.

a, Flower; *b*, flower opened to show the insertion of the eight stamens; *c*, pistil; *d*, stamen; *e*, fruit; *f*, horizontal section of fruit; *g*, seed; *h*, embryo.

The species known as Myrobalans are tropical shrubs or trees, with alternate or opposite leaves destitute of stipules, and long slender stamens. The order does not contain any plants of much importance for their useful properties. Some of them are astringent and used for tanning, and the kernels of others are eatable; they are chiefly valued for their brightly coloured showy flowers, especially in the genus *Combretum*.

COMEPHORUS, a genus of Fishes belonging to the family of Gobies. There is only one species, which is found in the fresh-water lake of Baikal. It is not taken by the fishermen, but is found dead on the shores after the severe storms to which that lake is frequently exposed. The fish is about a foot in length, and of a soft greasy texture. It is collected and pressed for oil, but is not eaten.

COMFREY. [SYMPHYTUM.]

COMMELYNA. [COMMELYNACEÆ.]

COMMELYNA'CEÆ, a very small order of Tripetaloideous Endogens, consisting of Plants with sheathing leaves, white or most frequently blue flowers inclosed in a green spathe, and a single 3-celled ovary terminated by a single style. They are moreover remarkable for their pulley-shaped (or trochlear) embryo lying in a particular cavity of the albumen. None of the species are European, nor of any known use. Many of them are common Indian weeds; others are handsome American herbaceous plants. The common Spiderworts are a good type of the order. They are in many respects allied to the Lilies. Brown compares them with Rushes. They may also be compared with Alismads. Lindley places them between *Liliaceæ* and *Bromeliaceæ*. There are 16 genera of this order and about 260 species.

Spiderwort (*Tradescantia Virginiana*).

a, Calyx, stamens, and pistil; *b*, stamen magnified; *c*, jointed hair from the filaments of the stamen; *d*, pistil; *f*, fruit; *g*, horizontal section of the seed-vessel; *h*, *i*, sections of seed; *k*, embryo; *l*, seed germinating.

COMMIA, a genus of Plants belonging to the natural order *Euphorbiaceæ*. It has diœcious flowers. The staminiferous flowers are formed of bracts united into an amentum; the stamens are numerous and united into a single column. The pistiliferous flowers are racemose, the calyx is 3-parted, the styles 3, the capsule 3-lobed.

C. Cochinchinensis is a small tree with a resinous juice. It has alternate entire smooth leaves. The male flowers are amentaceous, the catkins consisting of imbricated 1-flowered scales, axillary and short; the female flowers racemose, terminal, and small. This tree yields a gum which possesses emetic and purgative properties. It is recommended in cases of dropsy, but has not been introduced into European practice. It is a native of Cochin China.

COMMINGTONITE, a Mineral belonging to the Silicate of Iron series. It is a compound of silica, iron, manganese, and soda.

COMOCLA'DIA (from κόμη, hair, and κλάδος, a branch), a genus of Plants belonging to the natural order *Anacardiaceæ*. It has hermaphrodite or monœcious flowers; a 3-4-parted permanent calyx, 3-4 long petals; 3-4 short stamens; a single ovary with no style, and a single stigma; an ovate 1-celled, 1-seeded drupe; the seed somewhat pendulous from a curved funiculus originating at the base of the cavity; no albumen.

C. dentata, Tooth-Leaved Maiden-Plum, has pinnated shining leaves, green above, with a round rachis 6 inches long, 6-10 leaflets on each side, with an odd one oblong, acuminate, spiny-toothed, veiny, and somewhat downy at the back. This plant is a tree reaching a height of about 30 feet. It is a native of the woods of Cuba and St. Domingo, where it is called Guao. It has an erect not much branched stem. A milky juice exudes from it, which is glutinous, and becomes black by exposure to the air. It stains linen and the skin black, which cannot be washed out of the former, and only comes off from the latter by the exfoliation of the cuticle. It is believed by the natives of Cuba that it is death for persons to sleep under this tree, especially if they are fat or of a full habit of body. It is, undoubtedly, a poisonous tree, although nothing is recorded of its mode of action on the system.

C. integrifolia has stalked leaflets, lanceolate, quite entire, smooth. It is a tree 20 feet high, with small scentless deep red flowers. The berries are black and succulent, and may be eaten with impunity, but are not pleasant to the taste. The wood is hard, of a fine grain, and reddish colour. The tree gives out a watery juice, which is slightly glutinous, and grows black on exposure to the air. Like the juice from the last, it stains linen and the skin indelibly. It is a native of Jamaica.

(Don, *Dichlamydeous Plants*; Lindley, *Flora Medica*.)

COMPO'SITÆ, the largest known natural order of Plants. It consists of Monopetalous Exogens with syngenesious stamens, and an erect solitary ovule in a simple 1-celled inferior ovary, the style of which is divided into two arms; the flowers are always arranged in dense heads, or capitula, and are surrounded by one or more external rows of bracts forming an involucre. Professor Lindley regards it as an alliance of several natural orders. It consists of herbs, shrubs, or trees, found in all parts of the world, but assuming an arborescent character only in warm latitudes: they occur in every conceivable variety of situation, are often exceedingly similar to each other in appearance, and have always been, from the birth of botany as a systematic science, the puzzle and reproach of systematists. Every succeeding writer, with a few exceptions, rendered the subject more complicated and difficult, till Cassini, a Frenchman, of good powers of observation, much patience in investigation, and a clear head, with the command of the rich materials included in the Paris herbaria, set steadily about a re-formation and re-examination of the whole order. In 1832 Lessing gave the world a synopsis of the genera of *Compositæ*, in which for the first time a clear, compendious, intelligible view of the order was systematically taken. Subsequently De Candolle, the celebrated botanist of Geneva, achieved the difficult task of systematising the *Compositæ* in an unexceptionable manner in his great work, 'Prodromus Systematis Naturalis Regni Vegetabilis.'

The old and generally adopted plan of breaking up *Compositæ* into primary divisions is that of Jussieu, which may be explained thus:— Every head of flowers, or florets, as they are technically named, has a central part, or disc, and a circumference, or ray: of these florets some are regularly tubular, with their limb cut into four or five segments; others are slit up on one side, opened flat, and turned towards the circumference of the head; the latter are named ligulate florets. When in a head of flowers all the florets are alike and ligulate, it belonged to the division *Cichoraceæ* (*fig. a*), as in the dandelion; if the florets of the disc were tubular, and those of the circumference only ligulate, it was referrible to *Corymbiferæ* (*fig. b*), as in the marigold; and when all the florets are alike tubular, both in the disc and ray (*fig. c*), it belonged to *Cynarocephalæ*, provided the involucre was at the same time stiff and ovate, as in the thistle. The latter character was necessary in order to distinguish *Cynarocephalæ* from those *Corymbiferæ* in which the ray is not developed, as common groundsel. To these three divisions a fourth has in later times been added under the name of *Labiatifloræ*, in consequence of the florets having distinctly two lips of unequal size. (*Figs. d* and *e.*)

These divisions have however been thought objectionable on several accounts, and De Candolle, following Cassini and Lessing, has trusted more to modifications of the style; the result of which is the following arrangement of the order in eight tribes:—

* *Tubulifloræ;* namely, with the hermaphrodite florets regularly tubular, and 5-toothed, seldom 4-toothed.

Tribe 1, *Vernoniaceæ*. Style of the hermaphrodite flowers cylindrical, its arms usually lengthened and subulate, rarely short and obtuse, always equally hispid in about all the length. The true stigma ending short of the middle of the arms of the style. A part of the rayless *Corymbiferæ*. (*Fig.* 1.)

Tribe 2, *Eupatoriaceæ*. Style of the hermaphrodite flowers cylindrical, with long somewhat club-shaped arms, which are covered externally near the end with papillose down. The true stigma but little prominent, and usually ending short of the middle of the arms of the style. A part of the rayless *Corymbiferæ*. (*Fig.* 2.)

Tribe 3, *Asteroideæ*. Style of the hermaphrodite flowers cylindrical, with linear arms, rather flat externally, and towards the end equally and finely downy. The true stigma produced about as far as the origin of the external down. A part of *Corymbiferæ*. (*Fig.* 3.)

Tribe 4, *Senecionideæ*. Style of the hermaphrodite flowers cylindrical, with linear arms having a pencil of hairs at the point; either truncated, or produced beyond the pencil into a short cone, or a long narrow hispid appendage. The true stigma broad and prominent as far as the pencil. A part of *Corymbiferæ*. (*Fig.* 4.)

Tribe 5, *Cynareæ*. Style of the hermaphrodite flowers thickened and knobby towards the upper end, and often pencilled at the knob,

the arms either distinct or grown together, and downy externally. Tho true stigma not prominent, reaching the apex of the arms, and then becoming confluent. All the *Cynarocephalæ*. (*Fig.* 5.)

* * *Labiatifloræ*; namely, with the hermaphrodite florets usually 2-lipped.

Tribe 6, *Mutisiaceæ*. Style of the hermaphrodite flowers cylindrical at the upper end, or rather knobby, the arms usually obtuse or truncated, very convex on the outside, and at the upper part covered with minute even down, or naked. (*Fig.* 6.)

Tribe 7, *Nassauviaceæ*. Style of the hermaphrodite flowers never knobby and thickened; the arms linear, rather loug, truucated, and pencilled at the point only. (*Fig.* 7.)

* * * *Liguliflorœ*; namely, with all the flowers hermaphrodite and ligulate.

Tribe 8, *Cichoraceæ*. Style cylindrical at the upper end, with rather long arms, which are somewhat obtuse and equally hairy; the true stigma terminating short of the middle of the arms. (*Fig.* 8.)

De Candolle estimates *Compositæ* at one-tenth of the whole vegetable kingdom. They are in some cases soporific, as lettuce and succory; in others they are diuretic, as various conyzas; some are tonic and stomachic, as wormwood and chamomile. Common artichokes with their succulent receptacles, and Jerusalem artichokes with their succulent tubers, are the only esculents. Many are beautiful objects to look upon, and are amongst our choicest garden flowers, as dahlias, marigolds, coreopsis, asters, &c.

For further information on this order see—ACHILLEA; ANTHEMIS; ARNICA; ARTEMISIA; ASTER; BARKHAUSIA; BELLIS; BIDENS; CALENDULA; CENTAUREA; CHRYSANTHEMUM CICHORACEÆ; CICHORIUM; CINERARIA; CONYZA; CORYMBIFERÆ; CREPIS; CYNARA; CYNARACEÆ; DAHLIA; DIOTIS; CARLINA; ERIGERON; EUPATORIUM; FILAGO; HELMINTHIA; HIERACIUM; HYPOCHŒRIS; INULA; LACTUCA; LAPSANA; LEONTODON; LINOSYRIS; SONCHUS; MULGEDIUM; PETASITES; PICRIS; PRENANTHES; PYRETHRUM; SENECIO; SOLIDAGO; OPORINIA; TANACETUM; THRINCIA; TRAGOPOGON; TUSSILAGO.

COMPOUND FLOWERS are the flower-heads of *Compositæ*; they are masses of small flowers collected upon a depressed axis, or receptacle, and surrounded by an involucre of floral leaves or bracts.

COMPT'ONIA, a genus of Plants belouging to the natural order *Myricaceæ*, named after Henry Compton, bishop of London, by whom the fine collection of plants attached to the episcopal palace at Fulham was formed. The male flowers have cylindrical loosely imbricated catkins, with deciduous 1-flowered bracts; 2 sepals; 6 stamens, adhering in pairs: the female flowers have ovate densely imbricated catkins, with 1-flowered bracts; 6 sepals, larger than the bracts; 2 capillary styles, and a 1-seeded nut. There is only one species, the *C. asplenifolia*, Sweet Fern. It is a small bush from 3 to 4 feet in height, yielding a powerful aromatic fragrance when rubbed between the fingers. It has long linear pinnatifid leaves, brown and rather downy on the under side, shining on the upper. It is a native of the woods and mountains of the United States, where it is a favourite domestic remedy for the cure of diarrhœa. It possesses tonic and astringent properties. It is a handsome shrub, and will thrive in a peat soil or sandy loam, and may be propagated by layers or suckers. It was called *Liquidambar asplenifolium* by Linnæus, but differs very much from that genus in its characters and properties. (Lindley, *Flora Medica*; Loudon, *Encyclopædia of Plants.*)

COMPTONITE, a Mineral, also called *Thomsonite*. Trimetric. In right rectangular prisms. Usually in masses having a radiated structure within, and consisting of long fibres or acicular crystals. Also amorphous. Cleavage parallel to the diagonal planes of the primary form. Fracture uneven, conchoidal. Hardness, scratches fluor-spar. Colour snow-white; lustre vitreous, inclining to pearly; transparent to translucent. Specific gravity, 2 to 4·7. Composition:—

Silica	38·3
Alumina	30·7
Lime	13·5
Soda	4·5
Water	13.0

It intumesces and becomes opaque, but the edges merely are rounded at a high heat. When pulverised it gelatinises with nitric or muriatic acids. It is distinguished from *Natrolite* and other *Zeolites* by its difficult fusibility. It occurs in Amygdaloid near Kilpatrick, Scotland; in Lavas at Vesuvius; in Clinkstone in Bohemia; also at Pelter's Point in Nova Scotia, in Trap.

CONCHA'CEA, a family of *Mollusca* in M. De Blainville's arrangement of the Animal Kingdom. The following is his definition of the family:—"Mantle closed before (en avant), above, and behind, where it is prolonged by two tubes more or less long, extensile, and either separated or united; abdomen constantly provided with a foot of slightly variable form, serving for locomotion. Shell nearly always regular, entirely closed, equivalve; umbones curved forward; hinge dorsal, complete—that is to say, with teeth and a ligament; this last either external or internal, short, and swollen (bombé); two distinct muscular impressions united below by a ligule more or less large, and very often inflected or returning backwards (rentrée en arrière).

"All the animals of this family live plunged more or less deeply in the sand or in the mud, but they are still able to come out of it sometimes."

M. Rang thus modifies De Blainville's definition, principally for the introduction of *Iridina* (which according to the observations of M. Deshayes could no longer be retained among the *Submytilacea*) and *Gratelupia*, a fossil species.

"Mantle closed, furnished with a considerable antero-inferior opening, for the passage of a foot, and presenting two posterior tubes more or less elongated, extensile, united or separated longitudinally, the lower one serving for respiration, and the upper one for dejections. Shell equivalve, generally regular, rarely gaping; umbones more or less curved forwards; hinge almost always with teeth; ligament short and swollen, internal or external; muscular impressions very distinct; united by a pallial impression more or less excavated posteriorly.

"Animals marine, rarely fresh-water."

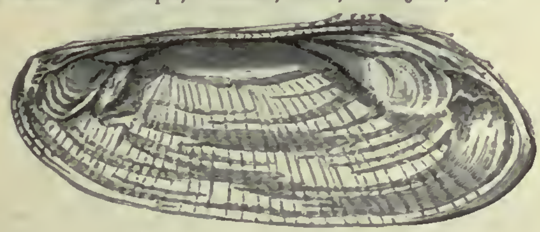
Cuvier, in his last edition of the 'Règne Animal,' at the foot of his definition of the *Cardiacea*, the fourth family of his Testaceous *Acephala*, has the following note:—"M. de Blainville en fait la famille des *Conchacées*." The following is Cuvier's definition of his Cardiacés:—"Mantle open in front (par devant), and moreover with two separate openings, one for respiration and the other for the excrements, which are prolonged into tubes sometimes distinct, sometimes united into a single mass. There is always a transverse muscle at each extremity, and a foot which most frequently serves for creeping. It may be regarded as a sufficiently general rule, that those which have long tubes live plunged in the mud or sand. One may recognise on the shell this condition of organisation by the more or less developed contour (contour plus ou moins rentrant), which the impression of the attachment of the borders of the mantle describes before uniting with the impression of the posterior transverse muscle."

These definitions appear contradictory, but in reality they are meant to convey the same ideas. The mouth is placed anteriorly, the foot is exserted inferiorly, and the tubes open posteriorly. The following is an arrangement of the genera:—

*

Hinge linear and toothless—freshwater. (Rang.)

Iridina.—Animal elongated, straight, rather thick on the back, thinner towards its inferior border; mantle delicate, terminated anteriorly by a thick border, open from the anterior muscle to two-thirds of the lower border for the passage of the foot; borders of the mantle united throughout the whole posterior part, whence spring two short and unequal tubes, with no retractor muscle to the siphons; foot compressed and sharp-edged. Shell, with an epidermis, nacreous or iridescent internally, tolerably thick, oval oblong, elongated, inauriculated, equivalve, inequilateral, the anterior end shorter than the posterior, a little gaping at either end; umbones small and projecting but little, slightly inclined; hinge very long, linear, attenuated towards the middle, often crenulated, as it were, throughout its length; ligament very long, marginal, external; muscular impressions very distinct. Example, *I. exotica*, Lam.; *I. elongata*, Sow.



Iridina exotica, one-third of natural size.

Lamarck gives the rivers of warm climates as the locality. The specimens were supposed to come from China. M. Caillaud found them in considerable abundance in the Nile; and from his specimens preserved in spirit M. Deshayes made his examination. Mr. G. B. Sowerby figures another species ('Zool. Journ.,' vol. i.), *I. Nilotica*, obtained from Sennaar by M. Caillaud, and sent to England by M. D'Audebard. It very much resembles the species given here as an example, but its hinge margin is not crenulated or dentated. M. Deshayes, in his last edition of Lamarck, makes it identical with *I. exotica*, Lam. and Desh., *Anadonta exotica*, Blainv., and Le Mutel, Adanson.

**

Hinge with Teeth.

a

Regular: Hinge-Teeth lateral and wide apart (marine).

Cardium [CARDIUM].—The species are numerous, and some grow to a very large size. M. Deshayes, in his edition of Lamarck, gives forty-eight, including *Hemicardium*, a form which Cuvier proposes to separate from the others, comprehending the species with compressed valves strongly carinated in the middle, observing that it is difficult to suppose that the animal is not modified in unison with this singular conformation. M. Rang corroborates Cuvier's observation, from the examination of many living individuals of *Cardium Cardissa*, the type; but M. Deshayes considers that the form can only be admitted as a section.

De Blainville divides the genus into the following sections:—

1. Species more or less gaping posteriorly, and with the ribs of the shell as large as the channelings. Example, *Cardium exoticum*.

2. Species not gaping, and with the ribs as large as the channelings. Example, *C. tuberculatum*.

3. Species not gaping, with the ribs larger than the channelings. Example, *C. edule*.

4. Smooth or almost smooth species. Example, *C. elongatum*.

5. Species whose anterior side is very short and nearly flat. Example, *C. hemicardium*.

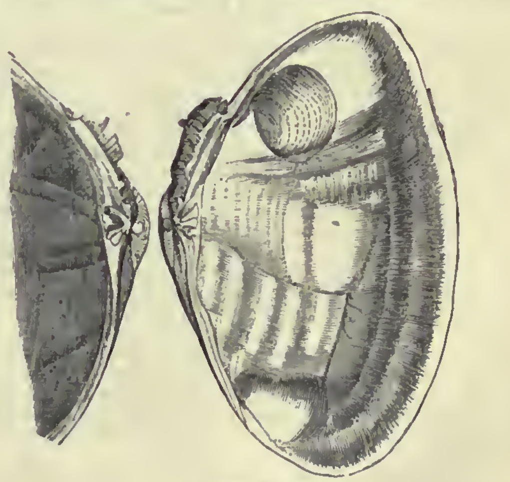
Several species have been added to this genus from the collection of Mr. Cuming.

The species of *Cardium* are found fossil.

1. Hinge of *Cardium elongatum*, natural size. 2. *Cardium* (*Hemicardium*) *Cardissa*, natural size; spotted variety.

Deshayes in his Tables gives fifty-three living species and thirty-nine fossil (tertiary), and *C. ringens*, *C. ciliare*, *C. echinatum*, *C. sulcatum*, *C. edule*, *C. tuberculatum*, and *C. planatum*, as both living and fossil species (tertiary). Of the recent species M. Deshayes, in his edition of Lamarck, where they are given as forty-eight, considers *C. Indicum*, *C. ringens*, *C. echinatum* (of which last he makes *C. tuberculatum* to be only a variety), *C. sulcatum*, and *C. edule* (common cockle) as identical with fossil species described by Brocchi and others under different names. The fossil species he makes amount to thirty. Of these he refers *C. echinatum* to its living analogue, *C. Burdigalinum* to the recent *C. Indicum*, *C. rhomböides* to the recent *C. edule*, and considers *C. diluvianum*, Lam., as identical with *C. hians*, Brocchi. The fossils occur in nearly all the fossiliferous strata from the Supracretaceous to the Grauwacke group, and appear to be most abundant in the Crag, London Clay, and Greensand and the contemporaneous beds.

Capsa.—Animal with the mantle considerably open at its ante-inferior border for the passage of a compressed and very large foot:



Capsa Braziliensis.

tubes separated and of considerable length, with tentacular papillæ at their orifices. Shell transverse, equivalve, inequilateral, not gaping;

cardinal teeth diverging from a point close to the umbo, no lateral teeth in one valve, in the other one distinct bifid cardinal tooth, and two distant very obsolete lateral ones; ligament external on the anterior side of the umbones; a large sinus in the pallial impressions.

The species are found in temperate and warm seas. They bury themselves at a small depth in the sand, where they are said to lie with the posterior part upwards to facilitate the influx of the water for respiration. The genus has been found in sandy mud and soft mud, at depths varying from five to twelve fathoms from the surface of the sea.

Mr. G. B. Sowerby has added a new species, *C. altior*, brought home by Mr. Cuming. ('Zool. Proc.')

Donax.—Animal rather compressed, more or less triangular, having the mantle bordered with tentacular appendages; labial appendages large; mouth small; branchiæ very unequal, on the same side; foot compressed, trenchant, angular; tubes separate and elongated, returning into a sinus of the mantle.

Shell more or less triangular and compressed, always longer than it is high, regular, equivalve, very inequilateral, posterior side shorter than the anterior; umbones but little prominent, and nearly vertical; hinge composed of two cardinal teeth, sometimes upon both valves, sometimes upon one only, and one or two lateral teeth more or less distant; ligament external, short and swollen; muscular impressions rounded, united by a pallial impression, which is straight and very much excavated posteriorly.

The species are widely extended. De Blainville says that they occur in all parts of the world. They plunge themselves in sand and sandy mud, where the animal lies with the short side of the shell uppermost, at a depth ranging from the surface of the sea to ten fathoms.

The species are numerous. M. Deshayes in his Tables enumerates twenty-nine living, and in his edition of Lamarck thirty of these. He considers *D. pubescens*, Linn., as having been established on a young individual of *D. scortum*; *D. granosa*, Lam., as a variety of *D. cuneata*;

Donax scortum.

D. triquetra, as approaching nearer to the *Cythereæ* than the *Donaces*; *D. ringens*, as belonging to the genus *Capsa*, Lam., if Lamarck's characters are rigorously followed; *D. cardioides* (the animal), as a proper subject for study, as it is very probable that it does not belong to the *Donaces*; the pallial impression is not notched posteriorly, and the hinge comes nearer to that of *Cardium medium* than those of the *Donaces*; and *D. Meroe* and *D. scripta*, as having more of the characters of *Cythereæ* than *Donaces*. Forbes and Hanley give the following species as British:—*D. anatinus*. It has the inner margin crenulated, and the hinge with lateral teeth. It is the *D. trunculus* of Linnæus. It is very common on all our shores. *D. politus* has the inner margin entire. It is the *D. complanatus* of Montagu, and is one of the most beautiful of our native shells. It is never common, and is much prized by collectors. It is found on the south coasts of England, and at Bantry Bay in Ireland.

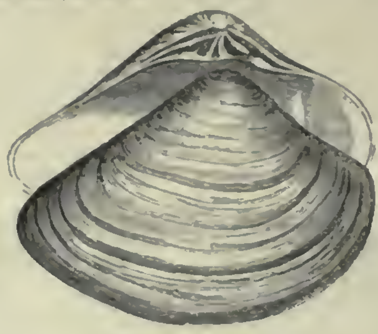
Lamarck divides the species into two sections: first, those which have the internal border of the valves entire or nearly so; second, those that have the internal border distinctly crenulated or dentated.

De Blainville separates them into five divisions, according to the shape, sculpture, and markings of the shell. His fifth division is the genus *Capsa* of Lamarck.

Mr. G. B. Sowerby, in his 'Genera of Shells,' says, "Of fossil species there are very few: Brocchi mentions two, and we possess a small one from Bordeaux, but we believe they are very scarce." De Blainville quotes Defrance for seventeen, three of which are analogues, one at Loignan, near Bordeaux, one in Italy, and a third in the environs of Paris. Deshayes in his Tables gives fifteen fossil (tertiary), and one only (*D. elongata*) as both living and fossil (tertiary). In his edition of Lamarck, the last-mentioned species is passed without any notice of its occurring in a fossil state; but *D. trunculus* is noticed as fossil, and Brocchi, 'Conch.,' t. ii., p. 537, No. 1, is quoted: nine fossil species only are given. The fossils are said to have occurred principally in the blue marls of the south of France, &c., the beds at Bordeaux and Dax, and in the oolitic group.

Gratelupia.—Shell subtrigonal, equivalve, regular, nearly equilateral, a little attenuated at its posterior part, and presenting at the postero-inferior border a slight sinuosity; umbones very small, not projecting, hardly inclined forwards; hinge with three cardinal diverging teeth in each valve, and from three to six cardini-serial teeth, lamellar, with finely dentelated edges, converging towards the summits, and situated a little below them, under the ligament; a single lateral tooth, anterior, beneath the lunule, in the left valve, corresponding with a hollow similarly situated in the right valve; ligament external, long, swollen, passing beyond the serial teeth; muscular impressions nearly equal, oval, united by a pallial impression largely and very deeply excavated posteriorly.

This genus, founded by M. Charles des Moulins, was confounded with the Donaces by M. de Basterot. M. Rang, who agrees with M. des Moulins on the propriety of this separation, says that there is but one species, *G. donaciformis*, which is fossil. It is found in the marine beds of Mérignac (tertiary). Dr. Lea, in his 'Contributions to Geology,' describes and figures another species, *G. Moulinsii*, from Claiborne, Alabama (America), here copied.



Gratelupia Moulinsii.

Tellina.—Animal generally very much compressed, considerably elongated; mantle moderately open at its antero-inferior part, and bordered with tentacular appendages; branchiæ unequal, on both sides; foot very much compressed, trenchant, and pointed before; tubes very much elongated, separated, and capable of being returned into a fold of the mantle.

Shell generally elongated, and very much compressed, equivalve, regular, sometimes slightly inequilateral; the anterior side not being always much longer than the posterior one, which is often angular, with a flexuous and irregular bend or fold at its lower border; umbones very small; hinge with three cardinal teeth, and two lateral ones which are often distant, with a hollow at their base in each valve; ligament posterior, swollen and elongated; a very small second ligament near the umbo; muscular impressions rounded; pallial impression straight, and very deeply excavated.

Lamarck makes the forms of *Tellina* and *Tellinides* distinctly generic. Mr. G. B. Sowerby follows Lamarck's arrangement, observing that of the *Tellinæ* there are many species, some of a form very much elongated in a transverse direction, as *T. rostrata*, *T. Spengleri*, &c.; others of an oval shape, some of which are rough on the outside, *T. linguafelis*, for example; others, again, nearly orbicular, *T. scobinata*, *T. carnaira*, &c.; a very few have one valve more flat than the other, *T. opercularis*, for instance: while both valves are remarkably deep in others, as in *T. lacunosa*. Of *Tellinides*, he says that the number of shells that may be ranged under it is rather considerable, although Lamarck has mentioned only one.

Both M. de Blainville and M. Rang think that these two forms belong to one genus, and M. Deshayes is of the same opinion.

The species are found in almost all seas, but more particularly in those of warm climates, where, like the *Donaces*, they live plunged in the sands and sandy mud; *Tellina* having been found in the former at depths varying from the surface of the sea to seventeen fathoms, and *Tellinides* in sandy mud at depths ranging from five to sixteen fathoms. Mr. G. B. Sowerby observes that they are commonly the prey of *Aporrhaides*, *Buccina*, and other carnivorous *Trachelipods*, which pierce the shell to devour the inhabitant.

The species are very numerous. M. Deshayes, in his Tables, makes the number of living species sixty-eight, and that of *Tellinides*, one. In his edition of Lamarck (1835), he records sixty-two only, the number of species of *Tellinides* being still one. Of these, he considers some as repetitions or varieties (*Tellina unimaculata*, *T. sulphurea*, for example, the first of which he considers a white variety of *T. radiata*, and the second as identical with *T. latirostra*, the only difference being that of colour), and others as founded merely on the difference of age, *T. chloroleuca*, for example.

Lamarck divided the species into—

1. Those with the shell transversely oblong. Example, *T. radiata.*

2. Those with the shell orbicular, or rounded oval. Example, *T. scobinata.*

De Blainville divides the genus thus:—

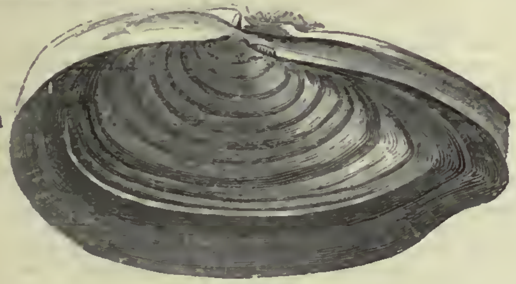
1. Subtriquetral species. Example, *T. bimaculata.*

2. Elongated species, but which have the posterior side shorter and narrower (plus étroit) than the anterior. Example, *T. radiata.*

3. Oval, or suborbicular, and nearly equilateral. Example, *T. scobinata.*

4. Equilateral species, sufficiently elongated, almost without a flexuous fold; two divergent cardinal teeth, and two distant lateral ones, of which the anterior is but little distant from the umbo. (*Tellinides*, Lam.) [TELLINIDÆ.]

1



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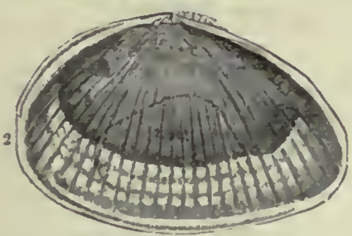


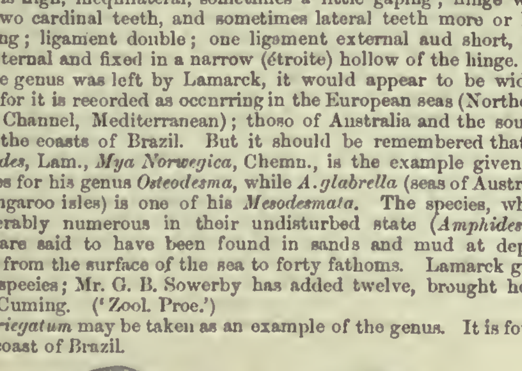
1. *Tellina rostrata.* 2. *Tellinides.*

The fossil species are recorded as occurring in the Supracretaceous group, in the Cretaceous group, and in the Oolitic group (Coralline Oolite, Yorkshire; Kimmeridge Clay; Bernese Jura). Sir R. Murchison mentions two species (probably) in the Salopian outlier of Lias.

Amphidesma.—Shell suboval or rounded, of little thickness, longer than it is high, inequilateral, sometimes a little gaping; hinge with one or two cardinal teeth, and sometimes lateral teeth more or less projecting; ligament double; one ligament external and short, the other internal and fixed in a narrow (étroite) hollow of the hinge.

As the genus was left by Lamarck, it would appear to be widely spread, for it is recorded as occurring in the European seas (Northern, English Channel, Mediterranean); those of Australia and the south; and on the coasts of Brazil. But it should be remembered that *A. corbuloides*, Lam., *Mya Norwegica*, Chemn., is the example given by Deshayes for his genus *Osteodesma*, while *A. glabrella* (seas of Australia and Kangaroo isles) is one of his *Mesodesmata.* The species, which are tolerably numerous in their undisturbed state (*Amphidesma*, Lam.), are said to have been found in sands and mud at depths varying from the surface of the sea to forty fathoms. Lamarck gives sixteen species; Mr. G. B. Sowerby has added twelve, brought home by Mr. Cuming. ('Zool. Proc.')

A. variegatum may be taken as an example of the genus. It is found on the coast of Brazil.



Amphidesma variegatum.

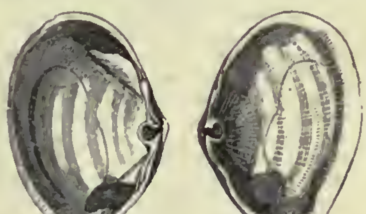
But few species have been found fossil.

Mesodesma (Deshayes).—Animal inclining to oval or subtrigonal, flattened; lobes of the mantle united for two-thirds of the posterior length, and provided, at their posterior extremity, with two short siphons prolonged within by a very delicate membrane; foot very much flattened, quadrangular, hidden in part by the branchiæ, which are short, truncated, and fixed (soudées) posteriorly, the external pair smallest and subarticulated. Shell oval, transverse or triangular, thick and ordinarily closed. Hinge with a spoon-shaped hollow, straight and mesial for the ligament, and, on each side, an oblong and simple tooth. (Deshayes.)

M. Deshayes remarks that the shells of this genus are easily recognised. The shell is always thicker than that of the *Mactræ*: they are more compressed, more completely closed (mieux fermées) and in this respect approach the *Crassatellæ.* The hinge is particularly remarkable; in the middle of the border and immediately below the umbo is placed a spoon-shaped triangular deep hollow, the border of which projects within the valves as in the greater part of the *Lutrariæ.* On each side of this spoon-like process, in which the ligament is inserted, is seen in each valve a large thick tooth, and behind is a hollow to receive the tooth of the opposite valve. Muscular impressions unequal; the anterior largest, elongated; the posterior somewhat rounded. The pallial impression in the species which approach the *Mactræ* has a moderate posterior sinuosity which diminishes more and more in proportion as the species have more resemblance to the *Crassatellæ.* The sinuosity exists however in all the species of the genus.

Cumingia (G. B. Sowerby).—A genus which should be placed near to *Amphidesma.* It is remarkable for the dissimilarity of the hinge of the two valves, one having a strong lateral tooth on each side of the ligament, and the other being entirely destitute of lateral teeth. Having only met with a small West Indian species, we could not venture to consider this genus as established, until Mr. Cuming showed us several species in his rich collection of South American and Pacific shells, one of which is sufficiently large to show the characters distinctly. ('Genera of Recent and Fossil Shells,' No. 40.) Mr. Sowerby characterises the shell as inequilateral, equivalve, with the anterior side rounded and the posterior rather acuminated. A single small anterior cardinal tooth observable in each valve: one strong lateral tooth on each side of the hinge in one valve, but no lateral tooth in the other valve; ligament internal, and affixed to a somewhat spoon-shaped pit in each valve. Muscular impressions two in each valve, lateral and distant, the anterior irregular and oblong, the posterior rounded. A very large sinus in the muscular impression of the mantle.

The species are found in the tropical seas as far as is yet known, in clay, mud, and sand, in the fissures of rocks, at a depth varying from the surface of the sea to six fathoms. No fossil species known. Example, *Cumingia mutica* (Sow.).



Cumingia mutica.

Mactra.—Animal oval, somewhat thick, with the borders of the mantle thick and simple, furnished posteriorly with two tubes but little elongated and united; branchial laminæ small and nearly equal; foot oval, trenchant, very long, angular. Shell transverse, inequilateral, subtrigonal, sometimes a little gaping at the sides; umbones protuberant; hinge with one cardinal tooth, folded into the shape of the letter V, the point being nearest the umbo and the branches diverging from it; posterior to this and very close to it is a very thin sharp tooth; sometimes the branches of the folding tooth are separated at the base, forming two diverging teeth; ligamental pit immediately behind the angular tooth and projecting within the shell. Lateral teeth, two on each side in one valve, one on each side in the other, diverging from the umbones, and very near the margin, thin, mostly elongated, and the inner ones more prominent than the outer, but in some species very short, in the thicker species perpendicularly striated. Muscular impressions two, lateral, distant; pallial impression with a small sinus. Ligament consisting of two portions (as usual), one, by far the larger, internal; the other external. In some species the umbones are separated, and the ligament forms a deep pit extending both within and without to the point of the beaks: of this *M. Spengleri* is an example.

"This genus," says Mr. G. B. Sowerby, "contains a great number of species, some of which are handsome and others very singular shells; upon examining a number of species we think it might be desirable to divide it into several genera, because we find several distinct forms in it." It is found in Europe, East and West Indies, Africa, North America, &c., buried generally in sandy mud and sands at a depth varying from the surface of the sea to 12 fathoms.

The species are numerous. Deshayes, in his Tables, gives thirty-two living; in his edition of Lamarck thirty-three; but in his opinion one of these, *M. donacia*, is not a *Mactra* but a *Mesodesma*, and others are repetitions or varieties.

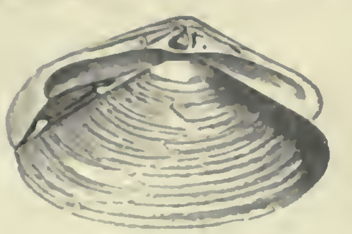
De Blainville thus divides the genus :—

1. Species whose cardinal teeth become nearly non-existent in consequence of the enlargement of the ligamental hollow. Example, *M. gigantea*.

2. Species all of whose teeth are very large, lamellar, and not striated. Example, *M. Stultorum*.

3. Thick and solid species without an epidermis; the lateral teeth finely striated; mantle pierced with two openings; but almost without tubes. Example, *M. trigonella*.

4. Very thick solid species striated longitudinally; cardinal teeth none or next to none; lateral teeth very thick, approximated, raised; an external ligament besides the internal one.



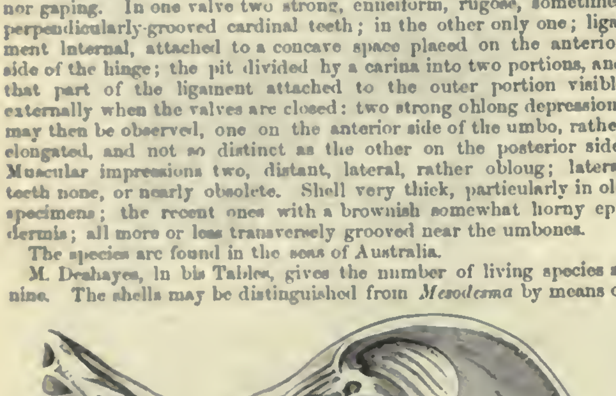
Mactra Brasiliana.

Mr. G. B. Sowerby says, "The fossil species are not numerous; they are only found in the tertiary beds, unless indeed some very singular fossils found in the secondary strata, particularly oolite, be truly referrible to this genus; of this however we cannot be certain, because we know not their hinges;" they will be found represented in Sowerby's 'Mineral Conchology.' De Blainville quotes M. Defrance for eighteen fossil species, one identical, one analogue in the Plaisantin, and another analogue "dans la Caroline du Nord." Deshayes in his Tables gives fourteen fossil (tertiary) and four as both living and fossil (tertiary): in his edition of Lamarck but three species are given as fossil only. Among the fossil shells from the borders of the Red Sea, collected by Mr. J. Burton and communicated by Mr. Greenough to Mr. Lyell, we find *M. Stultorum* with a (?). Mr. Lea gives three species, *M. dentata*, *M. Grayi*, and *M. pygmæa*, from the Claiborne beds. [MACTRIDÆ.]

Crassatella.—Shell equivalve, transverse, inequilateral, not attached nor gaping. In one valve two strong, cuneiform, rugose, sometimes perpendicularly-grooved cardinal teeth; in the other only one; ligament internal, attached to a concave space placed on the anterior side of the hinge; the pit divided by a carina into two portions, and that part of the ligament attached to the outer portion visible externally when the valves are closed: two strong oblong depressions may then be observed, one on the anterior side of the umbo, rather elongated, and not so distinct as the other on the posterior side. Muscular impressions two, distant, lateral, rather oblong; lateral teeth none, or nearly obsolete. Shell very thick, particularly in old specimens; the recent ones with a brownish somewhat horny epidermis; all more or less transversely grooved near the umbones.

The species are found in the seas of Australia.

M. Deshayes, in his Tables, gives the number of living species at nine. The shells may be distinguished from *Mesodesma* by means of



Crassatella Kingicola.

the pallial impression, which is always simple in the *Crassatellæ*, and always sinuous posteriorly in *Mesodesma*.

Mr. G. B. Sowerby, in his 'Genera,' mentions *C. tumida* and *C. compressa* from the Calcaire Grossier of the environs of Paris, and *C. sulcata* as very common at Hordwell, and as appearing to be characteristic of the London Clay. M. Deshayes remarks upon that shell, that Lamarck regarded the fossils at Beauvais and those living at Australia as analogues; but that he has satisfied himself that those fossils and *C. sulcata* are different species. *C. tumida*, he observes, approaches *C. Kingicola* nearer than any other.

De Blainville states that there are seven at least fossil in France, and that M. Defrance mentions twenty from the lower chalk with some doubt. In his Tables M. Deshayes gives twenty-four fossil species (tertiary): in his edition of Lamarck he records fourteen only. It appears in the catalogues in the Supracretaceous and Cretaceous groups.

Other genera belonging to De Blainville's *Conchacea* will be found under LITHOPHAGIDÆ, and the genera separated from *Venus*, or allied to that family, under VENERIDÆ.

CONCHI'FERA, Lamarck's name for that large class of Molluscous Animals which are protected by shells consisting of two principal pieces commonly known under the denomination of Bivalves. It comprises the whole of the Acephalous Mollusks of Cuvier, including the *Brachiopoda*. [BRACHIOPODA.]

Lamarck divided the class into two great orders, the *Dimyaria* (Dimyaires), or Conchifers, furnished with two adductor muscles, and the *Monomyaria* (Monomyaires), or Conchifers furnished with one adductor muscle only. M. Deshayes would separate the class into three sub-classes:—1, the *Polymyaria*, or *Brachiopoda*; 2, the *Dimyaria*; 3, the *Monomyaria*. He founds this order of arrangement on the principle that the organisation of the *Brachiopoda* is more simple than that of the other Conchifers, while that of the *Dimyaria* is somewhat less complex than that of the *Monomyaria*. The two last divisions are now more generally called *Lamellibranchiata*, from the fact that in nearly every case the branchiæ, or gills, occur in the form of four riband-shaped lamellæ, two of which are attached to each lobe of the mantle.

The following account of the structure of the *Conchifera* refers more especially to the *Lamellibranchiata* :—

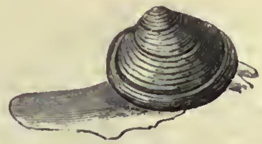
Digestive System.—Mouth without any hard parts, situated anteriorly: in the Dimyarians concealed between the foot and the anterior retractor muscle: in the Monomyarians under a sort of hood made by the mantle. Labial palps or lips flattened, sometimes truncated, sometimes laminated internally, more or less elongated, extending on either side. No salivary gland. Œsophagus varying in length and capacity, often wanting altogether both in Dimyarians and Monomyarians. Stomach sometimes, not often, lengthened and narrow, sometimes subcircular, generally pear-shaped; interior surface with irregular depressions, or biliary crypts. Intestine arising posteriorly, convoluted within the liver and ovary, and so brought towards the back and mesial line of the animal, and continued posteriorly to the vent, nearly of the same diameter all through. Rectum, which commences with the dorsal part of the intestine, shorter in the Monomyarians than in the Dimyarians: in the former it is convoluted behind the single central adductor, and terminates in a floating vent between the edges of the mantle; in the latter the vent is situated above the superior adductor. Liver very large, supported by muscular fibres, which traverse it, pouring the bile into the stomach by the biliary crypts.

Circulatory and Respiratory System.—Circulation, a simple circuit of two vascular systems, namely, a ventricle and an arterial system—a venous system and two auricles, the ventricle firmly and closely embracing the rectum, so that it appears to pass through it. The arterial system not complicated, the venous system upon a considerable scale of development. Circulating fluid nearly colourless, or white, scarcely tinged with bluish, slightly viscid, and with very little crassamentum. [BLOOD.] "Circulation then is an extremely simple function in the Conchiferous Mollusks; an aortic ventricle gives the blood impulse enough to carry it through the two systems of vessels, to expel it from the heart, and to carry it back again to the auricle. In other branchiferous animals the auricle is sometimes adapted to give the blood a new impulse when it is about to pass through the branchiæ; here, on the contrary, the auricles do not receive the blood until it has been exposed to the revivifying influence of the organs of respiration." (Deshayes.) The respiratory function is carried on by means of branchiæ variously disposed. They are all however disposed in a lamelliform manner.

The reproductive system consists simply of an ovary enveloped in the visceral mass. Taking the common oyster for example, it rests, a whitish mass of considerable size, upon the adductor, and may be seen through the mantle. It occupies the whole upper part of the mollusk, and creeps down along the sides and lower parts, being filled at the time of reproduction with a milky fluid, containing multitudes of small globules of a whitish colour. These are the eggs; and in many of the family they are not at the time of their exclusion abandoned at once, but are deposited between the two membranes of the branchial laminæ, where they undergo a kind of incubation. In some the shell is developed in the ovum before it quits this receptacle. This fostering of the eggs seems to be analogous to the gestation of the eggs in the *Crustacea* and the pipe-fishes. Sir Anthony Carlisle ('Hunterian Oration,' 1826) says, "Oysters are viviparous, and their young are found within the tracheal passages and between the folds of the coverlet (mantle) during the months of June and July in this climate. In its first state the oyster exhibits two semi-orbicular films of transparent shell, which are continually opening and closing at regular intervals. The whole brood are associated together by being involved in a viscid slime, and in that state called the 'spat,' it being common among viviparous animals of this kind to have their spawn posited in contact with the lungs. The involving slime serves as the first nutriment: and we may infer that the fœtal food so influenced by the gills is at the same time a respiratory supply to the imperfectly formed young." In the siphoniferous branch of the family the longer the siphons the larger, as a general rule, is the mass of the ovary: in those forms which have the siphons short and the foot comparatively large the ovary is comparatively small. As far as anatomy has hitherto detected this part of the organisation, here we have hermaphroditism in the true sense of the word. The whole business of reproduction is apparently carried on within the two valves of the shell without the aid of a second individual, as it is in a hermaphrodite flower. But it will occur to most observers that the *Conchifera* are gregarious; the Fixed Conchifers (Oysters, *Spondyli*, *Chamæ*, &c., for instance) eminently so; and it is by no means clear that this congregation may not be a necessary condition for the fecundation of the ova; and that there may not be a mutual diffusion of some influence analogous to that of the milt in fishes. M. Prevost, who made his experiments upon the *Uniones*, would make it appear that though there can be no union, still no propagation takes place without an assemblage of these animals upon the same spot.

The muscular system, as it regards motion, is two-fold; valvular and locomotive. The first consists in the adaptation of muscular fibre to the movement of the valves, and indeed this muscular apparatus may in some cases be made ancillary to locomotion, as in the Pectens, for example. The adductor muscles are attached to opposite points in each valve, and their office is to close the valves by their contractility, or suffer them to expand by their relaxation. In the greater number (*Dimyaria*) there are two; one anterior near the oval aperture, the other posterior. The *Monomyaria* have apparently one only; but Poli has shown that this muscle is in reality an approximation of two, and thence most probably arose the slight regard manifested by Cuvier for the division of Lamarck. The second or true locomotive organ is called the foot, and is formed of various layers of fibres, which by their counteraction bestow on it great power of motion when the organ is well developed. Though in some species merely rudimentary it is found in all the *Dimyaria*, not so in the *Monomyaria*, some of which are entirely without it. Its place may be defined by stating that the mouth is generally hidden between its base and the anterior adductor. Where well developed it is of various shapes, cylindrical, flattened, &c. In some it is a digging organ, or kind of ploughshare for making a furrow in the sand or mud wherein the animal means to lie hid; in others, as in the cockle, &c., it becomes a leaping organ, and enables the conchifer to clear a boat's gunwale when laid on the bottom boards. The foot is the instrument which produces the byssus. [BYSSUS.] The following is Deshayes's account of the structure:—"If the byssus and foot of a byssiferous mollusk be placed under a powerful lens, the last filaments of the byssus are first seen to be nearest to the base of the foot; and if the inferior edge of the foot be inspected, a fissure will be found running completely along it, at the bottom of which a brownish and semicorneous filament is often to be perceived: this is neither more nor less than a filament of the byssus prepared to be detached by the animal, in order to which the animal stretches forth its foot until it encounters the object upon which the other fibres of the byssus are fixed; to this it applies the point of the foot, which then secretes a small quantity of glutinous matter continuous with the silky filament lying along the bottom of the furrow of which we have spoken. When the pasty matter has acquired sufficient consistency, and is firmly fixed to the stone or other body at the bottom, the animal retracts its foot, and in doing so detaches the new fibre at the base of the pedicle. The mode in which the filaments of the byssus are formed is consequently entirely different from that in which hair or the horns of the higher animals are evolved, and it is easily understood when the intimate structure of the foot of the byssiferous mollusks is known, when we are aware that this organ consists in its centre of a pretty considerable fasciculus of parallel and longitudinal fibres. By a faculty peculiar to the class of animals that now engages our attention the fibres situated at the bottom of the groove of the foot become horny, and are detached in succession in the form of threads as they become consolidated." The siphons, which are the organs by which these animals take in and throw out water, are retracted by means of two lateral fan-shaped muscles, situated posteriorly.

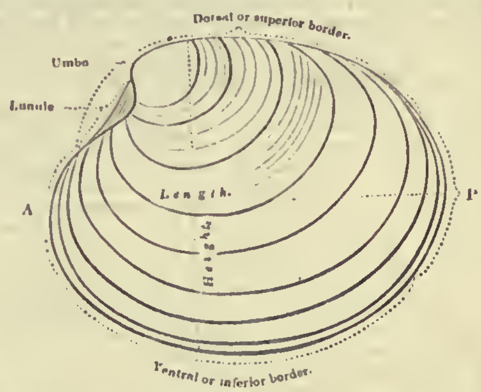
Mantle and Cuticular System.—Two thin fleshy laminæ applied over the back of the animal, extending over its sides, and with its edges meeting along the anterior middle aspect of the body, covering, or closely in contact with, the whole interior surface of the shell, form the mantle, in the thickened edge of which is the principal apparatus that secretes the shell: there are also frequently rows of contractile tentacular cilia fringing it. The whole of these parts are exquisitely sensible, and highly contractile. The mantle becomes free at the origin of the branchiæ, and forms a cavity round the lower part of



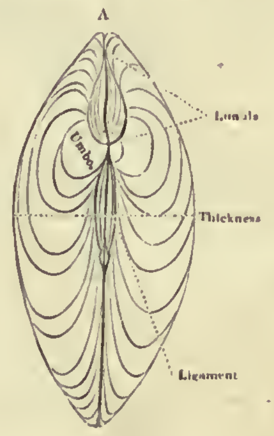
Cycias cornea.

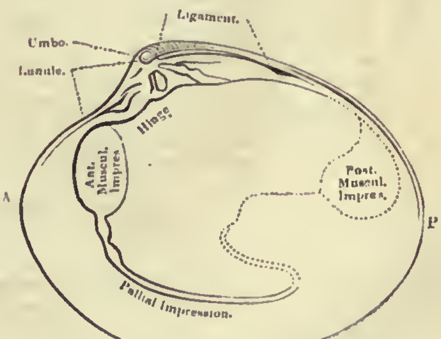
Unio Pictorum.

A, anterior or oral extremity; P, posterior or anal extremity, with the siphons or tubes; H, Hinge; F, Foot.



A, anterior or oral extremity; P, posterior or anal extremity.





Shell of *Cytheræa.*

the animal, containing the visceral mass, the foot, for the extrusion of which there is an opening, and the branchiæ. This is the pallial sac, and is the area wherein the currents for respiration and nutrition are formed. The siphons, where they exist, project from the mantle, with which they are continuous. They are sometimes very long, and sometimes reduced to mere perforations; sometimes separate, and sometimes conjoined; but in any case the superior siphon is that destined for dejections, and is called the anal siphon, while the office of the lower one is to conduct the water to the branchiæ, whence it is termed the branchial or oral siphon. The structure of these posterior siphons or tubes is eminently contractile, and their apertures are fringed with a number of papillæ of great sensibility, capable of giving notice of the contact of any prejudicial foreign body. The retractor muscle is generally more or less developed according to the greater or less development of these parts.

The nervous system is very simple. Symmetrical in the *Dimyaria*, hardly symmetrical in the *Monomyaria*. They have no true brain. In the *Dimyaria* there is a ganglion above the œsophagus on each side of the mouth towards the labial palps, connected by a transverse filament, crossing the œsophagus. From these ganglions filaments are given off to the mouth, anterior adductor, &c.; and from their posterior edges two nervous branches go to the stomach, liver, and heart, ovary, and branchiæ. A branch of some volume goes down to the foot. The lateral filaments, after advancing along the internal surface of the posterior adductor, are conjoined into one or two ganglions larger than the anterior ones. These posterior ganglions give off the nerves to all the posterior parts; if the ganglions are much separated a nervous filament connects them. In the *Monomyaria* the system is less perfectly developed.

The senses of these animals are very limited; and indeed there is no good ground for attributing to the generality of them anything beyond a sense of touch and taste. That most of them may be conscious of the presence or absence of light is possible. "Not having any especial organs for seeing, hearing, or smelling," says Sir Anthony Carlise, speaking of the common oyster, in his 'Hunterian Oration' (1826), "the creature is limited to perceive no other impressions but those of immediate contact; and yet every part of its exterior seems to be sensible to light, sounds, odours, and liquid stimulants. It is asserted by fishermen that oysters, in confined beds, may be seen, if the water is clear, to close their shells whenever the shadow of a boat passes over them."

M. Deshayes goes so far as to say that no especial organ of sense can be detected among them, unless perhaps those of touch and taste; but we must not forget what have been called the eye-specks in *Pecten*, to the animal of which Poli gave the name of *Argus*, from the supposed number of its visual organs. The pectens are free swimmers, and, from their rapid and desultory motions, we have heard them termed the butterflies of the ocean. The manner in which these motions are executed, especially on the approach of danger, indicates the possession of a sense analogous at least to that of ordinary vision. These eye-specks may be seen in the pecten placed at short intervals round the thickened edge of the mantle, on the outworks, as it were, of the internal part of the animal fabric. "As locomotion so vision" is a general aphorism, not without its particular exception; for there is good reason for believing that *Spondylus*, which is a fixture in its adult state, is furnished with these visual specks.

The following arrangement of the *Conchifera* proposed by M. Deshayes, is published in the 'Cyclopædia of Anatomy and Physiology':—

CLASSIFICATION OF THE CONCHIFERA.

Families.

MOLLUSCA ACEPHALA BIVALVIA

- DIMYARIA ....
  - The lobes of the mantle united in a greater or less degree posteriorly ......
    - TUBICOLÆ ....: *Aspergillum*, *Clavagella* — *Fistulana*,
    - PHOLADARIÆ ....: *Septaria*, *Teredo*, *Teredina*, *Pholas*
    - OSTEODESMATA ....: *Pholadomya*, *Osteodesma*, *Periploma*, *Anatina*, *Thracia* — **Pandora*; *Corbula**, *Mya*; *Thracia*, *Corbula*, *Mya*, *Lutraria* — *Anatinella*
    - MACTRACEÆ .. ..: *Lutraria*, *Mactra*, *Mesodesma*, *Crassatella*, *Erycina*, *Amphidesma*
    - TELLINIDES ....: *Tellina*, *Psammobia*, *Donax*
    - CONCHÆ........ . . .: *Astarte*†, *Venus*‡ — Glauc-on-ome
    - CYCLADES ....: *Cyclas*, *Cyrena Cyrenella*‖, *Galathea*
    - CARDIACEÆ ....: *Cypricardia*, *Isocardia*, *Cardium*§ > *Opis*
    - TRIDACNEÆ ....: *Tridacna*, *Hippopus*
  - The lobes of the mantle disunited ....
    - NAYADES.... .. ..: *Cardita*, *Unio*
    - TRIGONEÆ ....: *Trigonia*, *Nucula*
    - ARCACEÆ ....: *Pectunculus*, *Arca*, *Cucullæa*
    - MYTILACEÆ ....: *Mytilus*, *Pinna*, *Avicula*
- MONOMYARIA
  - Having a foot..........
    - MALLEACEÆ ....: *Malleus*, *Vulsella*, *Crenatula*, *Perna* — *Gervillia*, *Inoceramus*, *Catillus*
    - PECTINIDES.... ... .: *Lima*, *Pedum*, *Pecten*, *Hinnites*, *Plicatula*, *Spondylus*
  - Having no foot ....
    - OSTRACEÆ ....: *Ostrea*¶

SOLENACEÆ: *Solenya*, *Solen*, *Panopæa*, *Glycimeris*, *Solenertus*, (from *Clavagella* and *Psammobia*)

PETRICOLÆ: *Galeommea*, *Saxicava*, *Petricola*, *Venerupis*;

LUCINIDÆ: †*Corbis*, ‖*Lucina*, *Ungulina*

CAMACEA: *Myochama*, §*Cleidothærus*, *Chama*, *Diceras**, *Etheria*

RUDISTES: **Spherulites*, *Hippurites*, *Caprina*

PLACUNIDÆ: ¶ *Placuna*, *Placunanomia*, *Anomia*†

† *Terebratula*,

The lobes of the mantle, the thick edges of which form the principal secreting organ, determine apparently the form of the shell. [SHELL, PEARL.] In the *Conchifera* it is bivalve, or composed of two pieces, often covered with an epidermis, joined at their upper edge (corresponding to the dorsal part of the animal) by a hinge.

The hinge is entirely formed by the inner layer of shell, and consists of either a simple cardinal process, or a serrated edge, or of projections, or teeth as they are called, and corresponding cavities into which they are inserted. To this hinge is superadded a ligament, which binds the two parts together, and keeps the parts composing the hinge in their places. The ligament is either internal or external, internal when it is hidden by the outside of the cardinal edge, external when it appears beyond it, and is highly elastic, being composed of a number of fibres parallel to each other, and perpendicular to the valves which they connect. This is a beautiful contrivance for the necessities of the animal. When undisturbed, the elastic ligament keeps the valves open, and the animal functions are carried on without any effort; when danger is apprehended, or circumstances require it, the adductor muscle or muscles contract, overcome the resistance of the hinge, and shut the valves close till they may be opened in safety. One of the earliest signs of the loss of vitality in the Conchifers is the more than ordinary wide gaping of the shell. This arises from the state of the adductor muscle, which being relaxed by death is no longer an antagonist to the elastic ligament.

The common oyster will serve as an example of the Monomyarians, and the cuts will give a general idea of the Dimyarians, their shell, and its muscular impressions.

CONCHODERMA. [CIRRIPEDIA.]

CONCHOLEPAS. [ENTOMOSTOMATA.]

CONCHOLOGY is that branch of science which teaches the structure and forms of the shells which are the hard external covering of the animals belonging to the class *Mollusca*. Although these shells present great variety of forms, and are variously marked, they are only a subsidiary part of the structure of the animals to which they belong. Hence amongst naturalists the shells are only studied in connection with the structure of the animals which inhabit them. An account of these animals, with their shells, will be found in the articles MOLLUSCA, BRACHIOPODA, TUNICATA, CONCHIFERA, GASTEROPODA, PTEROPODA, CEPHALOPODA; also under the heads of the more important of the families and genera of the *Mollusca*.

CONDAMINEA, a genus of Plants belonging to the natural order *Cinchonaceæ*. It has a campanulate calyx, 5-crenate or 5-toothed limb, deciduous; corolla funnel-shaped, with a somewhat curved tube, which is a little longer than the calyx, a dilated throat, and a 5-parted limb; stamens inserted above the middle of the tube or near the throat; anthers oblong, linear, bifid at the base, length of corolla; stigma 2-lobed. Capsule turbinate, truncate, opening in the middle of the cells. Seeds numerous, very small, wedge-shaped. The species are American shrubs, with 2-parted acuminate stipules and terminal many-flowered corymbs.

C. corymbosa is a native of the hills and ravines of the Peruvian Andes. It has ovate-oblong leaves, acuminate, cordate, sessile, plicated, coriaceous; corymbs large, brachiate, trichotomous; corolla purple externally, with the throat and filaments naked; teeth of the calyx broad, short, and blunt. The bark is febrifugal. The bark-gatherers of Peru are said to use this plant for adulterating samples of *Cinchona*. Its bark is only slightly bitter, and may be easily recognised by its being white inside, rather bitter, and viscid.

C. tinctoria is a native of South America, and is used occasionally as a dye.

(Lindley, *Vegetable Kingdom;* Lindley, *Flora Medica.*)

CONDOR, or *Cuntur*, one of the largest Birds belonging to the family *Vulturidæ*. Of the size and habits of this bird many exaggerated accounts were at one time current. It was compared to the Roc of the Arabian romance-writers; nay, by some it was considered identical with that monstrous oriental conception. In the 'Musæum Tradescantianum,' under title 'Clawes,' we find "the claw of the bird Rock, who, as authors report, is able to trusse an elephant." This may have been the claw of a Condor, exaggerated by some of the artists who wrought extraordinary zoological forms for the collectors of the day. Near the passage quoted there is a notice of a toucan's (Aracari's) bill, and other parts of birds from Brazil and 'the West Indies.' In the old French 'Encyclopédie,' after noticing Condamine's statement, the writer adds that it is believed that these birds exist also in the region of Sophala, of the Kaffirs, and of Monomotapa, as far as the kingdom of Angola, and that it is supposed that they do not differ from those which the Arabians call 'rouh.'

Ray, in his 'Synopsis,' confesses that such was the enormous and almost incredible magnitude attributed to it, that he at one time considered the Condor the mere offspring of fiction; that he dared not insert the bird in Willughby's 'Ornithology;' and that it was to Sir Hans Sloane, who possessed a feather plucked from the wing of one shot on the coast of Chili, and presented to him by Captain Strong, who gave him at the same time the measurement of the bird, that he first owed his belief of its existence.

Joseph Acosta, Garcilasso de la Vega, and John de Laet, all speak of this vulture. Acosta says that the birds called Condors are of great magnitude, and of such strength that they are not only able to eviscerate and devour a sheep, but even an entire calf. Garcilasso enumerates among the rapacious birds those called Cuntur, and corruptly by the Spaniards Condor, and states that some of those killed by the Spaniards measured 15 or 16 feet from tip to tip of the extended wings. He further observes that nature, in order to temper their ferocity and strength, has denied them the crooked talons which she has bestowed on the eagle, and given them claws more like those of the Gallinaceous Birds; but that she has however endowed them with a beak sufficiently strong to perforate and tear off a bull's hide, and to rip out its entrails. Two of them, he adds, will dare to attack a cow or a bull, and will devour it; "neither do they abstain from the human race, but will set upon and slay single-handed boys of ten or twelve years, and it is by a providence of nature, for the protection of the flocks and the natives, that many are not hatched; for, if they were numerous, they would cause great slaughter among the herds, and the greatest damage to the inhabitants." The account given by John de Laet, who speaks of the 'vasta moles' of the bird, is much the same with that of Garcilasso.

In relation to the Condor's alleged attack upon children, Condamine notices a story of the Indians setting up a figure of a child made of very viscous clay; on this the Condors were said to pounce, and so entangle their claws that they were held fast.

Abbeville assures his readers that it is twice the size of the most colossal eagle. Desmarchais gives eighteen feet as the extent of the wings, which, he says, are so enormous that the bird can never enter the forest; and he adds that it will attack a man, and carry off a stag. Linnæus seems to have drawn up his account of the habits of the bird from the writers above noticed, some of whom he quotes. "It preys," says Linnæus, "on calves, sheep, nay, on boys of ten years; a pair will tear up and devour a cow;" and he adds, that the rushing of its wings, as it nears the earth, renders men planet-struck, as it were, and almost deafens them—"in terram devolans, susurro attonitos et surdos fere reddit homines:" he makes the alar extent from 13 to 16 feet. These marvellous stories were left to work upon the minds of men always prone to receive the wild and the wonderful; for, till within the last forty or fifty years, one or two specimens, and those not perfect, were the only evidences of the Condor in the cabinets of Europe.

The Great Vulture of the Andes was a striking instance of the way in which things imperfectly known are exaggerated. "It was with the Condor," observes Vieillot, "as it was with the Patagonians,—"both shrank before examination." To the scrutiny of the Baron Von Humboldt and of M. Bonpland we owe the reduction of the bird to its proper dimensions. Nestling in the most solitary places, often upon the ridges of rocks which border the lower limit of perpetual snow, and crowned with its extraordinary comb, the Condor for a long time appeared to the eyes of Humboldt himself as a winged giant, and he avows that it was only the measurement of the dead bird that dissipated this optical illusion. The grand scenery among which it is found had a precisely contrary effect on Lieutenant Maw ('Journal of a Passage from the Pacific to the Atlantic'), who, in describing his descent into the deep and narrow valley of Magdalena, says: "Whilst descending, several condors hovered round us, and about the rocks on which they build their nests; but so vast was the scale of the rocks and mountains, that even these immense birds appeared quite insignificant, and I doubted for a time that they were condors."

Under the name of Zopilote, a word derived from the Mexican word Tzopilotl, which is said to signify 'King of the Vultures,' M. Vieillot places the Condor in the same genus with the bird usually termed 'the King of the Vultures' (*Vultur papa* of Linnæus and others), and the Californian Vulture (*Vultur Californianus*, Latham and others). His Latin name for this genus is *Gypagus*. Mr. Bennett adopts this arrangement, and, as his description of the bird is accurate, and evidently made from personal observation, we give it the preference. "The condor," writes Mr. Bennett, "forms the type of a genus, a second species of which is the *Vultur papa* of Linnæus, the 'King of the Vultures' of British writers. They are both peculiar to the New World, but approach in their most essential characters very closely to the vultures of the Old Continent, differing from the latter principally in the large fleshy or rather cartilaginous caruncle which surmounts their beaks; in the large size of their oval and longitudinal nostrils, placed almost at the very extremity of the cere; and in the comparative length of their quill-feathers, the third being the longest of the series. The most important of these differences—the size and position of their nostrils—appears to be well calculated to add to the already highly powerful sense of smell possessed by the typical vultures, and for which these birds have been almost proverbially celebrated from the earliest ages. There is also a third species, the Californian vulture, two noble specimens of which, the only pair in Europe, are preserved in the Society's museum, rivalling the condor in bulk, and agreeing in every respect with the generic characters of the group, except in the existence of the caruncle, of which they are entirely destitute.

"In size, the condor is little, if at all, superior to the bearded griffin (the Lämmergeyer of the Alps), with which Buffon was disposed conjecturally to confound it, but to which it bears at most but a distant relation. The greatest authentic measurement scarcely carries the extent of its wings byond 14 feet; and it appears rarely to attain so gigantic a size. M. Humboldt met with none that exceeded 9 feet, and was assured by many credible inhabitants of the province of Quito that they had never shot any that measured more than 11 feet. The length of a male specimen somewhat less than 9 feet in expanse, was 3 feet 3 inches from the tip of the beak to the extremity of the tail; and its height, when perching, with the neck partly withdrawn, 2 feet 8 inches. Its beak was 2¾ inches in length, and an inch and a quarter in depth when closed.

"The beak of the condor is straight at the base, but the upper mandible becomes arched towards the point, and terminates in a strong and well-curved hook. The basal half is of an ash brown, and the remaining portion towards the point is nearly white. The head and neck are bare of feathers, and covered with a hard, wrinkled, dusky reddish skin, on which are scattered some short brown or blackish hairs. On the top of the head, which is much flattened above and extending some distance along the beak, is attached an oblong firm caruncle or comb, covered by a continuation of the skin which invests the head. This organ is peculiar to the male. It is connected to the beak only in its anterior part, and is separated from it at the base in such a manner as to allow of a free passage of the air to the large oval nostrils which are situated beneath it at that part. Behind the eyes, which are somewhat elongated and not sunk beneath the general surface of the head, the skin of the neck is, as it were, gathered into a series of descending folds, extending obliquely from the back of the head over the temples to the under side of the neck, and there connected anteriorly with a lax membrane or wattle, capable of being dilated at pleasure, like that of the common turkey. The neck is marked by numerous deep parallel folds, produced by the habit of retracting the head, in which the bird indulges when at rest. In this position scarcely any part of the neck is visible.

"Round the lower part of the neck both sexes, the female as well as the male, are furnished with a broad white ruff of downy feathers, which forms the line of separation between the naked skin above and the true feathers covering the body below it. All the other feathers, with the exception of the wing-coverts and the secondary quill-feathers, are of a bright black, generally mingled with a grayish tinge of greater or less intensity. In the female the wing-coverts are blackish gray; but the males have their points, and frequently as much as half their length, white. The wings of the latter are consequently distinguished from those of the female by their large white patches. The secondary quill-feathers of both sexes are white on the outer side. The tail is short and wedge-shaped. The legs are excessively thick and powerful, and are coloured of a bluish-gray, intermingled with whitish streaks. Their elongated toes are united at the base by a loose but very apparent membrane, and are terminated by long black talons of considerable thickness, but very little curved. The hinder toe is much shorter than the rest, and its talon, although more distinctly curved, is equally wanting in strength; a deficiency which renders the foot much less powerful as an organ of prehension than that of any other of the large birds of the raptorial order."

This bird is found in the Andes, and the greater part of the vast mountain chain which runs up South America to 7° N. lat., but most common in Peru and Chili.

The Condor is found most frequently at an elevation of from 10,000 to 15,000 feet above the level of the sea, and there they are to be seen in groups of three or four, but never in large companies, like the true vultures. Many of the clusters of rocks and of the elevated plateaux are named after them Cuntur Kahua, Cuntur Palti, and Cuntur Huacana, for example—names which, in the language of the Incas, are said to signify the Condor's Look-out, the Condor's Roost, and the Condor's Nest. In this rarefied atmosphere the bird breathes freely, and resorts to the plains only when impelled by hunger. Then two of them will attack the vicuña, the guanaco, the heifer, and even the puma, the lion of South America, persecuting the tormented quadruped till overpowered it falls beneath the wounds inflicted by their claws and beaks, groaning and protruding its tongue. Upon this and the eyes, their favourite morsels, the Condors instantly seize, and the bloody banquet is continued till they are quite gorged. Humboldt saw them after such repasts sitting sullen and sombre on the rocks; and when thus overloaded, they will suffer themselves to be driven before the hunter rather than take wing. But he has also seen them, when on the look-out for prey, and especially on serene days, soaring at a prodigious height, as if for the purpose of commanding the most extensive view. "C'est l'oiseau," says Cuvier, speaking of the Condor, "qui s'élève le plus haut." With regard to the stories of their carrying off children, Humboldt never heard of an instance, although the infants of the Indians who gather snow for sale are frequently left sleeping in the open air in the midst of the haunts of these birds. He often approached within a few feet of three or four of them as they sat on the rocks, but they never manifested any disposition to attack him: and the Indians of Quito assured him that men have nothing to fear from Condors: he admits indeed that two of these vultures would be dangerous antagonists for a single man to cope with; and Sir Francis Head describes a severe struggle between one of them and a Cornish miner, with his usual graphic power. When the bird descends into the plains, it rarely perches on trees, preferring the ground, for standing and walking on which its toes and straight claws are better adapted.

Humboldt was assured that the eggs, which are white, and three or four inches in length, are deposited on the bare rock without any border of straw or other defence. The young ones are said to remain with the female during one year. The nestlings have no feathers; their bodies for some months are covered with a very fine curling whitish down or hair, something like that of young owls; and they are so puffed out by this envelope, that they look almost larger than adults. At the age of two years the Condor is not yet black, but of a yellowish-brown; up to this time the female has no appearance of the white ruff (*golilla* of the Spaniards), and it is owing to want of observation on this change of plumage that many naturalists and travellers—nay, the inhabitants of Peru themselves—talk of two species of Condor, the black and the brown (Condor negro y Condor pardo). Thus Lieutenant Maw, in the sequel to the passage above quoted, says, "There were two kinds of Condors; one dark-brown, the other white on the back, with half the upper side of the wings next the back, and a white ring round the neck."

At Peru, Quito, and in the province of Popayne, Condors are taken alive with the lasso. To this end a cow or a horse is killed. Down come the Condors, and are permitted to gorge themselves. Then the Indians, with their lassoes, appear on the scene, and soon capture them. When one of the birds finds itself hampered, it makes incredible efforts to raise itself in the air, and succeeds, after vomiting freely. The Spaniards call this sport 'correr Buitres,' and it is, next to the bull-feasts, the great amusement of the country people. In other countries it is said that poisonous herbs are placed in the belly of the quadruped that serves as a bait, and then the Condors appear as if intoxicated after their meal.

The tenacity of life exhibited by the Condor almost rivals the endurance of the Grisly Bear. [BEAR.] Humboldt relates that at Riobamba he saw some Indians first strangle one with a lasso and hang it on a tree, pulling it forcibly by the feet for some minutes. The lasso was hardly removed when the Condor arose, and walked about as if nothing extraordinary had happened. At less than four paces, three balls were then discharged from a pistol at it, all of which entered its body, wounding it in the neck, chest, and abdomen: the bird still kept its legs. Another ball broke its thigh, and brought it to the ground; but the wretched creature did not die till after an interval of half an hour. Ulloa asserts that in the colder parts of Peru the skin of the Condor is so closely covered with feathers, that eight or ten balls may be heard to strike it without penetrating its body.

This celebrated vulture, *Vultur Gryphus* of Linnæus, *Gypagus Gryffus* of Vieillot, *Sarcoramphus Gryphus* of Duméril, is said to possess a most exquisite sense of smelling. It may be doubted however whether, as in other vultures, the eye is not at least as great an assistant to the bird in discovering its prey as the nostrils are. [BIRDS.] Lieutenant Maw saw the Condor's quill used as a pen in the Cordillera (Toulca).

The Condor (*Sarcoramphus Gryphus*, male).

The Zoological Society of London have now made this bird, of which such romantic tales were told and credited, familiar to the whole population of the metropolis. It is a striking contrast to rise from the perusal of one of these marvellous stories, and look at the living bird in the Regent's Park.

CONDROLITE. [MACLURITE.]

CONDURRITE, a Mineral found in Cornwall. It is an arsenate of copper of a brownish-black or blue colour. It gives out, like the other arsenates, an alliaceous odour when heated on charcoal before the blow-pipe.

CONDYLU'RA, Illiger, a genus of Insectivorous *Mammalia*, founded on the *Sorex cristatus* of Linnæus. Cuvier observes that Desmarest was the first who made the peculiar dentition of the genus known.

It has the following characters:—Body thick, furry; muzzle much elongated, bordered with membranous crests, disposed star-like round the opening of the nostrils; no external auricles; eyes extremely small; anterior feet short, large, with five toes, furnished with robust claws proper for digging; posterior feet slender, with five toes: length of tail moderate.

$$\text{Incisors, } \frac{2}{4}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{8-8}{7-7}=40.$$

Teeth of *Condylura cristata* (F. Cuvier).

Lesson observes that the generic name rests on an error made by La Faille, who had represented the radiated mole with knotty swellings on the tail; but it is generally received by zoologists. The genus is allied to the Moles and to *Scalops*.

The species are entirely confined to North America, as far as is known at present. Speaking of some specimens of *Condylura longicaudata* in the Museum of the Zoological Society, obtained from Moose Factory, Hudson's Bay, Sir John Richardson says, "They were not accompanied by any account of their habits, or notice of the exact locality where they were killed; but, as the most southern fur posts depending upon Moose Factory are situated upon the borders of Lake Superior, it is probable that they came from that quarter. Pennant's specimen was received from New York."

C. macroura (Harlan), the Thick-Tailed Star-Nose. The following is Sir John Richardson's description of a specimen presented to him by the unfortunate Mr. David Douglas, and which the latter had procured on the banks of the Columbia River.

"The head is remarkably large; the body is thick and short, and becomes narrower towards the tail, and the hind legs are consequently nearer to each other than the fore ones. The nose is rather thick, and projects beyond the mouth; it is naked towards its end, is marked with a furrow above, and terminates in a flat surface, which is surrounded by 17 cartilaginous processes, with two more anterior ones situated above the nostrils, and a pair of forked ones immediately below the nostrils. The surfaces of these processes are minutely granulated. Some white whiskers spring from the side of the nose, and reach about half the length of the head. There are others not so long on the upper and under lips. The fur on the body is very soft and fine, and has considerable lustre. It is longer than the fur of the other two known species. Its colour on the dorsal aspect is dark umber-brown, approaching to blackish-brown. On the belly it is pale liver-brown. When the fur is blown aside, it exhibits a shining blackish-gray colour towards its roots. It is longer on the hind-head and neck than on the belly. The tail is narrow at its origin, but it suddenly swells to an inch and a half in circumference; it then tapers gradually until it ends in a fine point, formed by a pencil of hairs, about half an inch long. It is round, or very slightly compressed, and is covered with scales about as large as those on the feet, and with short, tapering, acute hairs, which do not conceal the scales. The hairs covering the upper surface of the tail are nearly black; those beneath are of a browner hue. The extremities are shaped almost precisely like those of the *C. longicaudata*. Only the palms and toes of the fore feet project beyond the body. The palms are nearly circular, and are protected by a granulated skin like shagreen. The sides of the feet are furnished with long white hairs, which curve in over the palms. The five toes are very short, equal to each other in length, and, together with the back of the hands, are covered with hexagonal scales. The fore claws are white, nearly straight, broadly linear, and acute, convex above and flat beneath. The palms turn obliquely outwards, which causes the fourth claw to project rather farthest; but the third one measures as much, the second is shorter, and the first and fifth are equal to each other, and a little shorter than the rest. The hind feet are also turned obliquely outwards, and are scaly, with a few interspersed hairs above, and granulated underneath. The sides are narrow, and present a conspicuous callous tubercle, posterior to the origin of the inner toe. The hind legs are very short, and are clothed with soft brown hair, a tuft of which curves over the heel. There are no hairs on the sides of the hind feet, like those which form a margin to the fore ones. The hind toes are longer than the fore ones, and are armed with more slender claws, which are white, awl-shaped, curved, and acute. They have a narrow groove towards their points underneath. Length of the head and body 4 inches 3 lines; of the head, 1 inch 6 lines; of the tail, 2 inches 6 lines, including the pencil of hairs at its extremity, 3 inches 3 lines; naked part of the nose, exclusive of the awl-shaped processes, $2\frac{1}{4}$ lines," &c. ('Fauna Boreali-Americana.')

Thick-Tailed Star-Nose (*Condylura macroura*).

Dr. Godman observes, that though the external ear in *C. cristata* is destitute of auricle, it is very extensive, and is situated at a short distance from the shoulder, in the broad triangular fold of integument connecting the fore-arm and head.

Two or three other species are known.

CONESSI BARK is the produce of a plant belonging to the natural order *Apocynaceæ*, a native of the western coast of Hindustan. It is the *Wrightia antidysenterica*, and is a valuable astringent.

CONFERVACEÆ, a name sometimes considered synonymous with *Algæ*. It is limited in systematic botany to a section of *Algæ*, consisting of simple tubular jointed species inhabiting fresh water. [ALGÆ.]

CONFERVITES, species of Fossil Plants, probably of the Confervaceous Family, occurring in the chalk of Bornholm and the south of England, in the Greensand of Maidstone, and Chalk-Marl of Hamsey. (Mantell.)

CONGER-EEL. [MURÆNIDÆ.]

CONGLOMERATE. This term is most usually applied by geologists to designate rocks more or less distinctly inclosing displaced fragments of mineral masses which had been consolidated at some previous epoch, and subsequently broken up, removed from their original site, and placed in circumstances such as to permit of their being re-aggregated, and more or less cemented together by intervening smaller particles. Thus the old red conglomerate on the borders of the Grampians is full of fragments of the still more ancient schistose and gneissic strata, worn by attrition in water, and reunited into a solid rock by interposed red sands. In some volcanic regions the materials thrown out by eruptions are re-aggregated into conglomerate, by the operation of water.

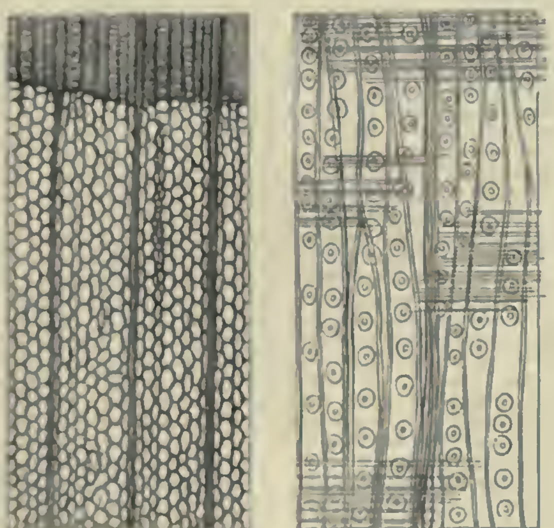
The coarser conglomerates are sometimes called Pudding-Stone. Conglomerates differ in their nature, and vary in the size of their component parts according to the process by which they have been brought into the form of conglomerate. Along the base of the Maritime Alps the rivers, with few exceptions, are now forming conglomerate and sand. (Lyell's 'Geology.') Near Nice the mud, pebbles, and portions of rock brought down by the torrents form beds of shingle; but the greater part are swept into the deep sea, where they form strata of inclined conglomerate, about 1000 feet in thickness and 7 or 8 miles in length. Volcanic eruptions also tend to the formation of conglomerate by uniting masses of rock together. Conglomerates, as already observed, to whatever causes owing, are characterised by being manifestly a congeries of fragments of rock, of various sizes, which have undergone the process of attrition, and consequently have been formed by fragments of various rocks that have been carried considerable distances. [BRECCIA.] Many of these conglomerates are sometimes so well compacted as to form a hard rock, capable of receiving a considerable degree of polish, as we observe in two colossal fragments of heads in the British Museum, the faces of which are tolerably smoothed by Egyptian art, while the broken parts exhibit a conglomerate consisting of irregular-sized rounded grains, and masses of quartz and other rocks. According as they consist of granite, quartz, limestone, &c., they are called granitic, quartzose, calcareous. In building, the conglomerates are generally only employed for the coarser kinds of work, as for foundations and the abutments of bridges.

CONIDÆ, a family of Gasteropodous *Mollusca*, including the genera *Conus* [CONUS] and *Pleurotoma* [PLEUROTOMA]. They are characterised by the shell being inversely conical; the aperture long and narrow; the outer lip notched at or near the suture; operculum minute and lamellar. The animal has an oblong foot truncated in front, with a conspicuous pore in the middle. The head is produced, and the tentacles are far apart. The eyes are attached to the tentacles. The gills are two. The lingual teeth are in pairs, elongate, subulate, or hastate.

Lamarck records nine fossil species of *Conidæ*. Deshayes in his 'Tables' makes the number forty-nine (tertiary), one of which, *C. Mediterraneus*, he gives as both living and fossil (tertiary). Mr. G. B. Sowerby ('Genera') says:—"Fossil cones are not unfrequent; but we believe that they occur only in the newer strata, or those above the chalk, such as the London Clay and Crag in England, the Calcaire Grossier in France, and the contemporaneous beds in other countries. There are a few seen in collections, filled with a coarse dark-green arenaceous substance; these belong to the Terrains Calcareo-Trappéens of Brongniart. Doubtful casts are met with in the inferior Oolite, according to Conybeare and Phillips." The same author gives a figure of *C. dormitor*, a fossil from Barton, approaching very near to a *Pleurotoma*. Many species are found in the blue marls of the south of France (M. Marcel de Serres). M. de Basterot gives many from Bordeaux and Dax, &c.; one of them, *C. deperditus* of Lamarck, as analogous to the existing species at Owhyhee. Among the fossil species from the western borders of the Red Sea, collected by Mr. James Burton, named by Dr. J. E. Gray and Mr. Frembley, and communicated to Sir Charles Lyell by Mr. Greenough, are twelve species all living; but neither *C. Mediterraneus* nor *C. deperditus* appears in the list.

Tennant in his List of British Fossils records three species of *Pleurotoma* in the Crag and nineteen in the London Clay, and nine species of *Conus* in the latter formation.

CONIFERÆ, a natural order of Gymnospermous Exogens (called by Dr. Lindley *Pinaceæ*), consisting of resinous, mostly evergreen, hard-leaved trees or shrubs, inhabiting all those parts of the world in which arborescent plants can exist. Under this name are collected the various races of fir-trees, pines, cedars, junipers, cypresses, and the like, which, however dissimilar they may at first sight appear, correspond not only in their universally terebintaceous sap, but in the following points of organisation:—They all branch from numerous buds, proceeding from the side of a main stem. Their wood consists of tubes of nearly equal diameter, among which there are here and there fistular cavities which receive the resin that exudes from the wood. The sides of the woody tubes are marked by circular discs, which when highly magnified appear as if consisting of a smaller internal and a large external circle: the nature and use of these discs are unknown. The following cut represents highly-magnified sections of a piece of deal. A shows the nearly equal size of the woody tubes when viewed transversely; B is a perpendicular section with the discs seen on the sides of the tubes.



A B

The leaves are articulated with the stem, and very often are linear, veinless, and sharp-pointed; but in some cases, as *Salisburia adiantifolia*, *fig.* 1, and *Podocarpus aspleniifolia*, *fig.* 2, the leaves become broad, and then they are filled with veins, which are all of the same size, and branch by repeatedly forking; a mode of veining known only in these plants and in ferns. The flowers are collected in little scaly cones; males in one cone and females in another. The females have no pericarpial covering, but consist of naked ovules, to which fertilisation is communicated directly from the pollen, without the interposition of a style or stigma. When the fruit is ripe it consists of a certain number of scales collected into a cone, and inclosing the naked seeds in their axils. Sometimes such scales are thin as in the larch, or hard and long as in the pine, or even succulent as in the juniper, whose berries, as they are named, are small cones with succulent consolidated scales.

Fig. 1. Fig. 2.

Salisburia adiantifolia. *Podocarpus aspleniifolia.*

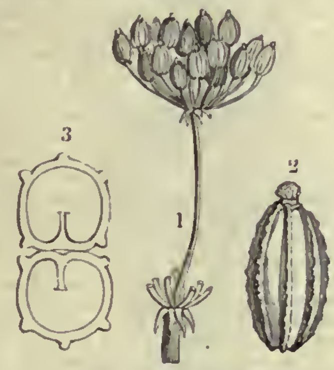
Lindley places this order between the *Cycadaceæ* and *Taxaceæ*. There are 20 genera and above 100 species, which include trees and shrubs of universal importance to mankind. Gigantic in size, rapid in growth, noble in aspect, robust in constitution, these trees form a considerable proportion of woods and plantations in cultivated countries, and of forests where nature remains in temperate countries in a savage state. They are natives of various parts of the world, from the perpetual snows of arctic America to the hottest regions of the Indian Archipelago. The principal part of the order is found in temperate climates. In Europe, Siberia, China, and the temperate parts of North America, the species are exceedingly abundant. The timber of these trees is exceedingly valuable in commerce, and is known under the names of Deal, Fir, Pine, and Cedar. Their resinous secretions are also well known by the names of Oil of Turpentine, Burgundy Pitch, Canadian Balsam, &c. The common Larch yields Venetian Turpentine; Liquid Storax is procured from a species of Pine; the branches of the Hemlock Spruce are used in making spruce beer; and the Savin, which is well known in medicine, is a species of Juniper.

CONIROSTRES, a family of Birds, the third amongst Cuvier's *Passeres*. It comprises those genera which have a strong bill, more or less conical, and without notches. Cuvier says that they live exclusively upon seeds, in proportion as their bill is more or less thick. The *Conirostres* form one of the five tribes of the order *Insessores* of Mr. Vigors. [BIRDS.]

CONIUM, a genus of Plants belonging to the natural order *Apiaceæ*, or *Umbelliferæ*. It has an obsolete calyx; petals obcordate, somewhat emarginate, with a very short inflexed lobe. Fruit compressed at the side; ovate. Half-fruits with five prominent equal undulated ridges, of which the lateral are on the border. Channels with many striæ, but no vittæ. Biennials. Root fusiform; stem taper-branched; leaves decompound; both involucres 3-5-leaved, the partial one-halved. Fowers white, all fertile.

C. maculatum, Hemlock, is found in waste places throughout Europe, the east of Asia, and the cultivated parts of America. It possesses highly narcotic and dangerous qualities, but is used medicinally as a remedy in nervous affections. It has a white fusiform biennial root; an erect branched bright-green spotted stem, from five to ten feet high, on which are planted so many smooth finely cut large fern-like leaves. When very healthy, and growing in a spot where it is neither injured by storms nor disfigured by dust, the Hemlock is one of the most noble of our wild plants. Its little greenish white flowers, arranged in umbels after the manner of its order, have a minute involucre of several leaves at the base; and the partial umbels have three or four short oval leaflets on one side. The fruit is globular, each half having five projecting angles, which are slightly crenelled, without either vittæ or appendages or projections between them. It grows in wild places, sometimes by the sides of ditches in meadows, but more frequently in light upland pastures, flowering in June and July. It is almost the only wild umbelliferous plant whose fruit is destitute of vittæ, and consequently not aromatic.

It is necessary to pay the greatest attention to the botanical characters of *Conium maculatum*, in order that the genuine plant may be collected. Sometimes plants resembling it are collected, which are almost or entirely inert when employed as a medicine; or plants possessed of greater potency are used in its stead, from which fatal results have followed. It is a "well-known circumstance that the greatest discrepancy prevails among medical men as to the activity of hemlock, not merely as a remedy but also as a poison." This discrepancy admits of satisfactory explanation on several grounds. The activity of the plant—even supposing the proper one to be collected—depends greatly upon its place of growth, the kind of season, the time when collected, and the means employed to dry it or form it into an extract; on the temperature and dryness of the place where it is preserved, and on the length of time it has been kept. In the



Fruit of *Conium maculatum.*

1, a partial umbel, loaded with fruit, natural size; 2, the back view of a fruit, much magnified; 3, a transverse section of the same, showing the ridges, the absence of vittæ, and the involute albumen.

south of Europe it is much more energetic than in the north, owing to the greater intensity of light; even in the southern provinces of France it is more powerful than in the northern. The wild plant, growing in well-exposed situations, is always to be preferred to a cultivated one; the kind of season markedly influences its power, which is greatest in a dry sunny season, and least in a wet gloomy one. The leaves during the first year of growth possess little potency; nor do they possess much during the early period of the second, till the flower-stem is developed, and the flowers are about to expand. If this period, which is the fittest time for collecting the leaves, is allowed to pass, it is better to wait two months longer, and collect the fruits instead, as they become the recipient of the active principle. The leaves should be dried quickly, but not by the application of a high temperature; they should never be powdered till the time when it is intended to use them, but preserved meanwhile in a cool dry place. If an extract be formed which requires much care in the preparation, it can rarely be kept beyond twelve months. A fresh supply of leaves, fruits, or extract, should consequently be procured every year, and the former thrown away, as the action of time or heat volatilises the active principle (Conia), and renders the residue nearly inert. When these precautions are attended to, Hemlock is a medicine of great power and unquestionable value.

The fresh leaves are dark green, shining: odour strong, stupifying, unpleasant, resembling that of mice, or the urinous odour of fresh Spanish Flies; when dried the colour is lighter, a grayish green; the taste is disagreeably saline, nauseously bitter, and at last somewhat acrid. The expressed juice is green.

According to Linnæus, sheep eat the leaves, but horses, cows, and goats refuse it. Ray informs us that the thrush will feed upon the seeds even when corn is to be had. The first physician who endeavoured to bring hemlock into repute as a medicine was Baron Stoerck of Vienna, who announced that it exerted extraordinary effects on the most inveterate chronic disorders in 1760. The whole plant is a virulent poison, but varying much in strength according to circumstances. When taken in an over dose it produces vertigo, dimness of sight, nausea, and paralysis of the limbs. In small doses however it is found very useful in scirrhus, scrofulous tumours, dropsy, epilepsy, and as an anodyne. Dr. Pereira and Dr. Christison recommend an alcoholic tincture of the bruised ripe fruit instead of the leaves.

In what way hemlock proves useful as a remedial agent in many diseases is by no means clear, unless it be by allaying irritability in the diseased parts, and giving an opportunity to the vital powers to recover their heathful action. That it lessens irritability in many diseased organs is certain, from the effects of the administration of even a few doses, especially in many cases of scrofulous affections, and above all from allaying the irritation of the lungs during the formation of tubercles, and indeed during all the subsequent stages of consumption. Even when inhaled along with the vapour of warm water the same good effect is said to follow, but this is rather doubtful. Its beneficial influence over external ulcers is however open to observation; and John Hunter remarked, that under the combined action of conium and cinchona-bark, many obstinate buboes, which resisted every other mode of treatment, soon took on a healing process. Many irritable or painful ulcers are soothed and improved by a hemlock poultice. Rheumatic pains, and those attending nodes, are said to be effectually allayed by conium and ipecacuanha. From the very decided sedative action of conia on the spinal cord, Dr. Gordon has suggested that it will prove a useful remedy in tetanus and other spasmodic diseases.

Dr. Christison is of opinion that the *Conium maculatum* of the present day is not the plant which furnished the poison employed to dispatch Phocion and Socrates. Waller considers it to have been *Cicuta virosa.* [CONIA, in ARTS AND SC. DIV.]

For further particulars with regard to the subject of this article we refer to Dr. Christison's 'Memoir on the Poisonous Properties of Hemlock and its Alcaloid, Conia.' ('Transactions of the Royal Society of Edinburgh,' vol. xiii.)

CONNARACEÆ, a natural order of tropical Trees or Shrubs allied to *Anacardiaceæ* and *Leguminosæ*. It contains 5 genera and about 40 species. The leaves are compound, not dotted, alternate, without stipules. The flowers terminal and axillary, in racemes or panicles, with bracts. Calyx 5-parted, regular, persistent; æstivation either imbricated or valvular. Petals 5, inserted on the calyx, imbricated, rarely valvate in æstivation. Stamens twice the number of petals, hypogynous, those opposite the petals shorter than the others; filaments usually monadelphous. Carpels solitary or several, each with a separate style and stigma. Ovules 2, collateral, orthotropal,

Connarus Asiaticus.

1, an expanded flower, much magnified; 2, its stamens and styles; 3, a section across the ovary.

ascending; styles terminal; stigmas usually dilated. Fruit dehiscent, follicular, splitting lengthwise internally. Seeds erect, in pairs or solitary, with or without albumen, often with an aril; radicle superior, at the extremity opposite the hilum; cotyledons thick in the species without albumen, foliaceous in those with albumen. Brown says the genus can be distinguished from Leguminous plants by the relation which parts of its embryo bear to the umbilicus of the seed; that is to say, by the radicle being at the extremity most remote from the hilum. From *Anacardiaceæ* and others they are at once known by their total want of resinous juice and their orthotropal ovules.

The species are all tropical; most common in America. The beautiful zebra-wood now so much used by cabinet-makers is ascertained to be produced by *Omphalobium Lamberti*, a large Guyana tree of this order.

CONNOCHETES. [ANTILOPEÆ.]

CONNOR, a Fish belonging to the family *Labridæ.* [CRENILABRUS.]

CONO'CERAS, a genus of *Cephalopoda*, fossil on Lake Huron. Bronn founds the characters of it on the form of the septa, which are convex towards the base of the cone.

CONOELIX, CONŒLIX, or CONOHELIX, a genus of Turbinated *Mollusca*, established by Mr. Swainson for a group which, in his opinion, "form a beautifully defined link connecting the Cones with the Volutes, strictly so termed." It has the following generic character:—"Shell coniform. Spire very short. Outer lip simple. Columella or pillar plaited. Aperture linear, narrow, longer than the spire. Generic type, *Conolix lineatus*." (Swainson.)

Mr. Swainson ('Zoological Illustrations') figures three species, and mentions that several specimens are in the Banksian collection from the Pelew Islands. To one of these species in that collection, Taheite, usually called Otaheite, is given as a locality. Mr. Cuming brought home another species, *C. Virgo*, which Mr. Swainson considers as representing *Conus Virgo*, from the reefs at the island of Rictea. It was in shallow water.

C. lineatus. "Shell smooth, whitish, with transverse capillary fulvous lines. Spire depressed, the apex prominent. Pillar six-plaited. Inhabits the South Seas (?)." (Swainson.) The figures, which are of the natural size, are copied from the accurate drawing in the 'Zoological Illustrations.' All the other known species are comparatively small.

Conolix lineatus.

De Blainville divides the genus *Mitra* into five sections, and makes his fifth consist of *Imbricaria*, Schum., and *Conolix*, Sow., meaning Sowerby; but the genus is Swainson's, and is generally adopted.

CONOPS, a genus of Insects belonging to the order *Diptera* and the family *Conopidæ*. The family *Conopidæ* is thus characterised:—Proboscis distinct, last joints of antennæ forming a short style. Wings perfect. Cubital vein simple; brachial veins without spurious vein; axillary lobe rounded. Halteres uncovered.

The genus *Conops* has the following characters:—Body of middle size, rather slender, generally adorned with yellow or red bands. Head thick, vesiculose, the crown especially, with a transverse vesicular tubercle; front broad in both sexes. Eyes prominent, oblong; ocelli none. Proboscis long, porrect, stiff, clavate, horizontal, or somewhat raised into a curve, geniculate at the base, arched above, hollow beneath, obliquely notched at the tip, much shorter than the labium. Lingua slender, filiform, transparent. Palpi uniarticulate, short, very small, fringed at the tips with fine bristles. Labium obliquely porrect, cylindrical, twice the length of the lingua, narrower towards the tip, most slender in the male, bilobed, slightly hairy, and with three shallow transverse furrows at the tip. Antennæ about as long as the head, porrect, seated on a tubercle, approximate at the base, diverging thence; first joint short, cylindrical, pubescent, forming an angle with the second; second long, sub-clavate; third conical, shorter than the second; fourth very short; fifth and sixth larger, widened on one side; sixth and seventh like a little spine. Thorax almost quadrate, slightly convex above, with a scapula on each side; scutellum small, semicircular. Wings lanceolate, finely pubescent, incumbent, and parallel in repose, præbrachial vein united with the cubital towards the tip; præbrachial and discal areolets long, the latter closed near the posterior margin by a transverse vein; anal areolet long, distinct, complete. Abdomen arched, rather long, with six segments more or less slender towards the base, obclavate towards the tip, which is incurved. Legs rather stout; tibiæ very slightly curved, compressed and dilated at the tips, in some cases with a transverse suture; tarsi rather broad; ungues and onychia distinct.

Male.—Abdomen with a projecting conical process on the fourth segment beneath.

These flies frequent flowers; their larvæ are parasitic on those of the humble-bee. There are twenty species of this insect in the collection at the British Museum, of these not more than three are found in England, the rest having been caught in the south of France, North America, and Australia.

A single specimen of *C. strigata* was found near Killarney, in Ireland, in the year 1850. (Walker, *Insecta Britannica*.)

CONOVULA. [MELAMPUS.]

CONULA'RIA, a fossil genus of *Mollusca*, generally ranked with *Cephalopoda*. [THECOSOMATA.]

CO'NULUS, a generic name for *Echinida*, to which also the term *Galerites* is applied.

CONUS, a genus of Gasteropodous *Mollusca*, founded by Linnæus. The animal is elongated, very much compressed and involved, with a very distinct head, terminated by a proboscis capable of much extension; mouth with a tongue rather short, but projecting, and armed with two rows of sharp teeth; tentacula cylindrical, carrying the eyes near the summit; foot oval, elongated, wider before than it is behind, with a transverse anterior channel; mantle scanty, narrow, forming an elongated siphon in front.

Shell thick, solid, rolled up as it were in a conical form; epidermis membranous, sometimes very thick; spire of different degrees of elevation, sometimes almost flat; aperture long and very narrow, widening a little anteriorly; lips generally straight and parallel, the outer lip simple and sharp-edged, sometimes a little curved, the inner lip without any plaits on the columella, but with a few elevated striæ on its anterior termination. Operculum horny, very small, subspiral, with a terminal summit, placed obliquely on the back part of the foot, and, when compared with the length of the aperture, appearing like a rudiment.

The species are found in southern and tropical seas. The form becomes gradually less developed as the locality approaches the north. In the Mediterranean there are a few species, but none appear to have been detected in the northern seas. They are carnivorous, and found on sandy mud at depths varying from near the surface of the sea to seventeen fathoms.

The species are very numerous. Lamarck records 181 recent; and several of these include varieties. The following observations of Mr. Broderip in his introduction to the description of some new species in the Cumingian collection may be of use to the student. After pointing out the difficulty of the task arising from the infinite varieties presented by the genus, and the very few points of form and structure in the shell that can be relied on as the foundation of specific character, the author thus continues:—"M. de Blainville, when noticing the numerous species already recorded, gives us a hint that many of them may be what Adanson calls 'espèces de cabinet,' and no one can examine an extensive collection of Cones, particularly if it contain many individuals of each species, for the purpose of comparison, without being struck by the force of the observation. Colour, granulation, or smoothness, length or shortness of the spire, its plainness or coronation, will be found in many species the result of locality, food, or temperature." M. Duclos, in reference to the numbers given by Lamarck, states that he is convinced that there are many of the species which can only be regarded as varieties at most. About 269 recent species and 80 fossil species have been described up to the present time.

Many of these species and varieties are very beautiful, both in shape and colour, and the genus has always been highly valued by collectors. *Conus gloria-maris*, *C. cedo-nulli*, *C. omaicus*, *C. aurisiacus*, *C. ammiralis*, and some others, have brought very large prices, and some of the finest specimens of these shells are now in this country.

Lamarck separates the genus into two divisions: the first comprising those species whose spire is coronated; and the second those whose spire is simple. By far the greater proportion of species belong to the latter division.

De Blainville thus divides the genus:—

a.

Conical species with a projecting spire, which is not crowned with tubercles. (Example, *C. generalis*.)

β.

(Genus *Rhombus*, De Montfort.)

Conical species with a coronated spire, which is either projecting or flattened. (Example, *C. imperialis*).

γ.

(Genus *Cylinder*, De Montfort.)

Species a little elongated, suboval; the spire projecting and pointed, but not coronated. (Example, *C. textile*.)

δ.

(Genus *Rollus*, De Montfort.)

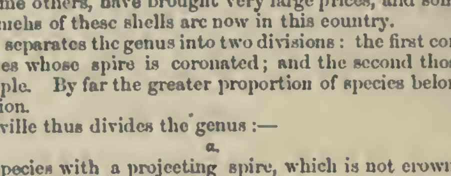
Subcylindrical species, the spire apparent and coronated. (Example, *C. geographus*.)

ε.

(Genus *Hermes*, De Montfort.)

Elongated, cylindrical species with a projecting spire, and the aperture as in the genus *Terebellum*, that is, angular posteriorly. (Examples, *C. Nussatella* and *C. mitratus*.)

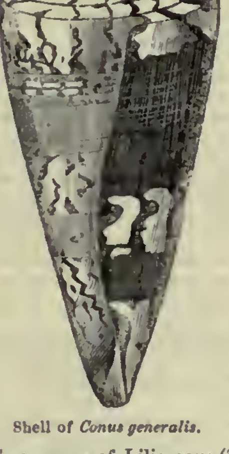
Mr. G. B. Sowerby ('Genera of Recent and Fossil Shells') observes that the Cones are liable to be confounded with the *Pleurotomata*, and the young specimens of some *Strombi*; and those which are rather



Animal of *Conus bandanus*.

a, seen in profile; *b*, view of under side; *c*, operculum.

ventricose with young *Cypræa*; but that they may be distinguished from the *Pleurotomata* by their short spire, their linear aperture, and their straight columella; from the young *Strombi*, by their being entirely destitute of varicose sutures, and by their never having any appearance of a notch near the lower extremity of the outer lip; the young *Strombi* moreover are seldom, if ever, so regularly cónical; and from the young *Cypræœ* by the thickness of their shell, by the coronated or abrupt spire, aud by their not being naturally polished in every part, which the *Cypræœ* always are, in cousequeuce of the want of epidermis which covers the shell of the Cone, while in the *Cypræœ* the large mantle comes in contact with the whole of the shcll.



Shell of *Conus generalis*.

CONVALLARITES, a genus of Liliaceous (?) Plants, fossil in thc Red-Sandstone of Sulzbad. (Brougniart.)

CONVOLVULA'CEÆ, a natural order of Monopetalous Exogcnous Plants, with bell-shaped flowers, opening or contracting beneath the influence of light, a plaited æstivation of the corolla, 5 stamens, and a fruit with 2 or 3 cells, in which 1 or 2 ovules stand erect. The embryo is crumpled up in the midst of very firm alhumen. The common Bind-Weeds of the hedges, the *Ipomœæ* and *Convolvuli* of the gardens, offer illustrations of the ordinary state of this order, the species of which have purgative roots; and in the case of scammony, yielded by *Convolvulus Scammonia*, and of jalap, produced by various species of *Ipomœa* [IPOMŒA], are of great medicinal importance. Occasionally the purgative principle is so much diffused among the fæcula of the root as to be almost inappreciable, as is the case in the *Convolvulus Batatas*, or Sweet Potato of America, which was the forerunner of the common potato, and gave it its name, and which is still cultivated in the south of Spain and France. [BATATAS.]

1, a bracteal leaf of *Neuropeltis racemosa*, with a flower growing from its midrib; 2, one of its flowers magnified; 3, a corolla opened, showing the stamens; 4, a small closter of flowers; 5, one of its ovaries with two styles; 6, a section of the calyx of a *Convolvulus*; 7, half a capsule, with valves separating by their edge from the dissepiments; 8, a transverse section of a seed, showing a part of the embryo lying in the albumen.

In most instances the stems of this natural order are twining, and in such cases it is immediately recognised; but occasionally they are erect and more spiny, and when that happens it is not so easy to know the order. If however attention is paid to the very imbricated state of the calyx, two of the sepals being quite exterior with respect to the other three, no real difficulty in identifying it need be experienced. For illustration we have taken a singular East Indian genus called *Neuropeltis*, in which the flowers grow from the midrib of the bracteal leaves.

The species are abundant in all parts of the tropics, but raro in cold climates where only a few are found. In the coldest climates they are unknown. The roots abound in a milky juice, which is strongly purgative: this property depends on a peculiar resin which is the active principle of jalap, scammony, and others of like nature. There are 43 genera and above 600 species. The order, according to Dr. Lindley, is allied to *Solanaceœ*, *Boraginaceœ*, and *Nolanaceœ*.

CONVOLVULUS, a genus of Plants belonging to the uatural order *Convolvulaceœ*. The species are chiefly herbs or herb-shrubs. The genus is known by the style being divided into 2 linear arms and its ovary having 2 cells in which stand 2 erect ovules. There are above 130 species of this genus. They are commonly kuown by the name of Bind-Weeds.

C. Scammonia, Scammony Bind-Weed, is a native of Syria, Cappadocia, and of the island of Rhodes, in hedges. It has large campanulate cream-coloured or very pale red corollas. The roots, which are very long and thick, when fresh contain a milky juice. This is obtained by removing the earth from the upper part of the roots, and cutting off the tops obliquely. The milky juice which flows out is collected in a vessel in the earth at the lower end of the cut. Each root furnishes a few drachms, and the produce of several roots is added together, and then dried in the sun. This is the true and unadulterated Scammony. It is light, of a dark gray colour, aud becomes of a whitish-yellow when touched with the wet finger. It seldom reaches us in a pure state, but is commonly mixed with the expressed juice of the root, and often with flour, sand, or earth. The best comes from Aleppo, and a second quality from Smyrna. Scammony is an efficaceous and powerful purgative. [SCAMMONY, in ARTS AND SC. DIV.]

C. arvensis has angular striated stems; leaves sagittate, somewhat auricled; peduncles usually 1-flowered; sepals ovate, rouudish; corolla white or rose-colour. It is native throughout Europe in sandy fields and by road-sides; also iu China, Persia, and some parts of India. It is very common in Great Britain. This species is said to possess a purgative quality, as also *C. Soldanella*, *C. maritimus*, and *C. macrocarpus*.

C. panduratus abounds in prussic acid, and is one of the plants from which the liqueur Noyau is prepared.

C. altrœoides is a native of the South of Europe, North of Africa, and Levant, climbing among hushes. It has stems branched from the bottom, climbing or spreading, taper and leafy; the corolla about two inches long, and of a beautiful rose-colour. According to M. Loiseleur Deslongchamps the roots contain a purgative resin, which is given in doses from 15 to 24 grains.

C. Soldanella and *C. sepium* are now referred to the genus *Calystegia* by Robert Brown. [CALYSTEGIA.] Several of the species are natives of Great Britain. Many grow well in our gardens, and form haudsome and showy flowers.

CONY'ZA, a genus of Plants belonging to the natural order *Compositœ*, to the sub-order *Tubulifloræ*, the tribe *Eupatoriaceœ*, the subtribe *Baccharideœ*, the division *Conyzeœ*, and the sub-division *Enconyzeœ*. It has an herbaceous imbricate involucre, the flowers of the ray tubular, 3-toothed, pistiliferous, those of the disc tubular, 5-toothed, hermaphrodite; the anthers caudate, the achenium beakless, the pappus pilose, the receptacle naked. The species are herbs and shrubs, and are found in Europe, Asia, Africa, and America.

C. squamosa, Floabane, Ploughman's Spikenard, has the scales of the involucre all linear, the lcaves ovate-lanceolate, downy, denticulate, the lower leaves narrowed into a footstalk, the florets of the ray subligulate, the fruit terete. This is a common plant on calcareous soils, in Great Britain and throughout Europe. It possesses a volatile oil with a peculiar scent, and is used for the purpose of driving away fleas and gnats. It seems to have had this reputation from an early period, as its names in most languages have reference to this quality. Its Latin name is *Pulicaria*; French, Hèrbes aux Puces; English, Fleabane. This species has been referred by De Candolle, in his 'Prodromus,' who is followed hy Babington, in his 'Manual,' to the genus *Inla*, under the name of *I. Conyza*.

C. anthelmintica has ovate or oval-oblong leaves, acuminate at hoth ends, coarsely serrated, and downy; the heads corymbose, each containing 40-50 florets; the scales of the involucre lanceolate, linear, acute, the outer somewhat spreading, leafly, and obovate-linear. It is a common plant among rubbish and in dry uncultivated ground in the East Indies. It is the *Vernonia anthelmintica* of Willdenow. The fruit is used by the doctors of India as a powerful remedy for worms.

C. genistelloides has very small lcaves reduced to sharpish somewhat ternate scales; 1-2 heads in interrupted spikes, the involucre turbinate, with the scales all acuminate. This plant is a native of Peru and Brazil. It is the *Baccharis genistelloides* of Persoon, the *Molina reticulata* of Lessing. It contains a bitter extractive matter and an aromatic oil, and is not unlike in its medicinal characters the common wormwood. It is employed in the Brazils in intermittent fevers, and may be used in all those cases where the Artemisia is indicated. It is particularly beneficial in the chronic diseases of horses, which are very fond of this plant. It may be employed in the form of an extract or decoction.

C. Marylandica has sessile, broad-lanceolate, acute, serrated leaves; the corymbs terminal and fastigiate. It is a native of North America, and secretes a powerful volatile oil, which gives out the odour of camphor. This property is also possessed by *C. camphorata*.

(Loudon, *Encyclopædia of Plants;* Koch, *Flora Germanica;* Lindley, *Flora Medica.*)

COOKIA, a genus of Plants belonging to the natural order *Aurantiaceæ*. The species are small trees with impari-pinnate leaves; leaflets alternate, unequal at the base, or oblique.

C. punctata is a native of China and the Moluccas; it has ovate lanceolate leaflets, acuminated, hardly unequal at the base. It is a middle-sized tree bearing eatable fruit about the size of a pigeon's egg, yellow on the outside, the pulp white, rather acrid, but sweet. This fruit is esteemed as an article of diet in China and the Indian Archipelago, and is known by the name of Wampee. There are two or three other species, natives of the East, all known as Wampee Trees.

COOT. [RALLIDÆ.]

COPAIFERA, a genus of Plants belonging to the natural order *Fabaceæ* or *Leguminosæ*, sometimes placed in the *Amyridaceæ*. It has a 4-parted calyx, segments diverging, the lowest the narrowest. Corolla wanting; stamens 10, declinate. Ovary roundish, compressed, with 2 ovules. Fruit pedicellate, oblique, obovate, 2-valved, 1-seeded; seed inclosed in a 1-sided aril. The species are trees or shrubs, inhabiting tropical America. Their trunks yield balsam by incision. The leaves are alternate, pinnated equally or unequally; leaflets opposite or alternate, either dotted or not. The flowers are arranged in compound axillary and terminal spikes.

C. Jacquini, the *C. officinalis* of Jacquin, is a native of the West Indies. The leaves are generally equally pinnated; leaflets in 2-5 pairs, incurved, ovate, unequal-sided, obtusely acuminate, with pellucid dots. From this species is obtained the Copaiva Balsam of the West Indies, which is used in medicine. [COPAIVA, in ARTS AND SC. DIV.]

Copaifera Jacquini.

C. multijuga has equally-pinnated leaves; leaflets 6-10 pairs, somewhat incurved, unequal-sided, with a long tapering point and pellucid dots, the lower ovate-oblong, the upper lanceolate. This is said to yield the Copaiva exported from Pará.

C. Langsdorfii grows in the province of S. Paulo in Brazil. It has leaflets in 3-5 pairs, equal-sided, obtuse, with pellucid dots; the lower ovate, the upper elliptical: the petioles and peduncles slightly downy.

The Copaiva Balsam of Brazil is furnished by this and the next species.

C. coriacea is also a native of S. Paulo in Brazil. It has leaflets in 2-3 pairs, elliptical, equal-sided, emarginate, not dotted; petioles and peduncles nearly smooth. The Balsam of Copaiva, an acrid bitter nauseous liquid resin, is apparently furnished by all the species of this genus; the above are given upon the authority of Hayne, who discontinues the name *C. officinalis*, which appears to have been applied indiscriminately to many different species.

The Purple Heart, a Guyana tree yielding timber of great toughness, which is very valuable for resisting the shock of artillery-discharges, and is therefore employed for making mortar-beds, is the *C. pubiflora* and *bracteata*. The balsam is said to gush out of the heart of these trees in large quantities when wounded.

COPAL, a resin possessed of peculiar properties, the produce of the *Rhus copallinum*, a native of Mexico; it is in rounded masses, smooth and brittle, transparent or nearly so, without colour or having a slight tinge of yellow; it has but little taste, and is nearly inodorous; it is insoluble in water, fusible, and inflammable. It differs from most other resins in its very sparing solubility in alcohol; and of the little that dissolves with the assistance of heat the greater part is deposited as the solution cools. It is dissolved by ether and some essential oils.

A substance resembling Copal is also found mineral, which is called *Fossil Copal*. It is however insoluble in alcohol.

CO'PHINUS, a fossil genus whose affinities are uncertain. (Murch. 'Sil. Syst.' pl. 26, f. 12.)

COPPER, one of the metals, occurs native in considerable quantities; also combined with oxygen, sulphur, selenium, and various acids. The ores of copper vary in specific gravity from 3·5 to 8·5, and seldom exceed 4 in hardness. Many of the ores give to borax a green colour in the outer flame, and an opaque dull red in the inner. With carbonate of soda on charcoal, nearly all the ores are reduced, and a globule of copper obtained; borax and tinfoil are required in some cases, where a combination with other metals conceals the copper. When soluble in the acids, a clean plate of iron inserted in the solution becomes covered with copper, and ammonia produces a blue solution.

NATIVE COPPER.—Monometric. In octahedrons; no cleavage apparent. Often in plates or masses, or arborescent and filiform shapes. Colour copper-red. Ductile and malleable. Hardness, 2·5 to 3. Specific gravity, 8·58.

Native copper often contains a little silver disseminated throughout it. Before the blow-pipe it fuses readily, and on cooling it is covered with a black oxide. It dissolves in nitric acid, and produces a blue solution with ammonia.

Native copper accompanies the ores of copper, and usually occurs in the vicinity of dykes of igneous rocks. Siberia, Brazil, and Cornwall, are noted for the copper they have produced. A mass, supposed to be from Bahia, now at Lisbon, weighs 2616 lbs. The vicinity of Lake Superior is one of the most extraordinary regions in the world for its native copper, where it occurs mostly in vertical seams in trap, and also in the inclosing sandstone. A mass weighing 3704 lbs. has been taken from thence to Washington city. One large mass weighing 80 tons was quarried out in the same district. It was 50 feet long, 6 feet deep, and averaged 6 inches in thickness. This copper contains intimately mixed with it about 3-10ths per cent. of silver. Besides this, perfectly pure silver in strings, masses, and grains is often disseminated through the copper; and some masses when polished appear sprinkled with large white spots of silver. Crystals of native copper are also found penetrating masses of prehnite and analcime in the trap rock. This mixture of copper and silver cannot be imitated by art, as the two metals form an alloy when melted together. It is probable that the separation in the rocks is due to the cooling from fusion being so extremely gradual as to allow the two metals to solidify separately at their respective temperatures of solidification; the trap being an igneous rock, and ages often elapsing, as is well known, during the cooling of a bed of lava covered from the air. Small specimens of native copper have been found in various parts of the United States. It occurs also in Australia.

Vitreous Copper Ore.—Trimetric. Cleavage parallel to the faces of a right rhombic prism, but indistinct. Secondary forms, variously modified rhombic prisms. It occurs also in compound crystals like arragonite; often massive. Colour and streak blackish lead-gray, often tarnished, blue or green, streak sometimes shining. Hardness, 2·5 to 3. Specific gravity, 5·5 to 5·8. Composition:—

Sulphur	20·6
Copper	77·2
Iron	1·5

Before the blow-pipe it gives off fumes of sulphur, fuses easily in the external flame, and boils. After the sulphur is driven off a globule of copper remains. Dissolves in heated nitric acid, with a precipitation of the sulphur. The vitreous copper ore resembles vitreous silver ore; but the lustre of a surface of fracture is less brilliant, and they afford different results before the blow-pipe. The solution made by putting a piece of the ore in nitric acid covers an iron-plate or knife-blade with copper, while a similar solution of the silver ore covers a copper-plate with silver.

This ore occurs with other copper ores in beds and veins. In Cornwall splendid crystallisations occur. Siberia, Hesse, Saxony, the Bannat, Chili, and the United States, also afford it.

Copper Pyrites—Sulphuret of Copper and Iron. Dimetric. Crystals tetrahedral or octahedral, sometimes compound. Cleavage indistinct. It occurs also massive and of various shapes. Colour brass-yellow, often tarnished deep yellow, and also iridescent; streak unmetallic, greenish-black, and but little shining. Hardness, 3·5 to 4. Specific gravity, 4·15 to 4·17. Composition:—

Sulphur	36·3
Copper	32·1
Iron	31·5

It fuses before the blow-pipe to a globule, which is magnetic, owing to the iron present. Gives sulphur-fumes on charcoal; with borax affords pure copper. The usual effect with nitric acid.

This ore resembles native gold and also iron pyrites. It is distinguished from gold by crumbling when it is attempted to cut it, instead of separating in slices; and from iron pyrites in its deeper yellow colour, and in yielding easily to the point of a knife, instead of striking fire with a steel.

Copper pyrites occurs in veins in granite and allied rocks; also in grauwacke, &c. It is usually associated with iron pyrites, and often with galena, blende, and carbonates of copper. The copper of Fahlun, Sweden, is obtained mostly from this ore, where it occurs with serpentine in gneiss. Other mines of this ore are in the Harz, near Goslar, in the Bannat, Hungary, Thuringia, &c. The Cornwall ore is mostly of this kind, and 10,000 to 12,000 tons of pure copper are smelted annually. There is much of this ore found in the United States. Besides being mined for copper, this ore is used extensively in the manufacture of blue vitriol (sulphate of copper) in the same manner that sulphate of iron (copperas) is obtained from iron pyrites.

Variegated Copper Pyrites.—Monometric. Cleavage octahedral, in traces. Occurs in cubes and octahedrons; also massive. Colour between copper-red and pinchbeck-brown; tarnishes rapidly on exposure; streak pale grayish-black, and but slightly shining. Brittle. Hardness, 3. Specific Gravity, 5. Composition:—

Sulphur	25·7
Copper	62·8
Iron	11·6

It fuses before the blow-pipe to a globule, attractable by the magnet. On charcoal affords fumes of sulphur. Mostly dissolved in nitric acid. This ore is distinguished from the preceding by its pale reddish-yellow colour. It occurs with other copper ores in granitic and allied rocks, and also in secondary formations. The mines of Cornwall have afforded crystallised specimens, and it is there called from its colour Horseflesh Ore. Other localities of massive varieties are—Ross Island, Killarney, Norway, Hesse, Silesia, Siberia, and the Bannat. Fine crystallisations occur in some of the United States.

Gray Copper Ore.—Monometric. Occurs in modified tetrahedrons, and also in compound crystals. Cleavage octahedral, in traces. Colour between steel-gray and iron-black; streak nearly as the colour. Rather brittle. Hardness, 3 to 4. Specific Gravity, 4·75 to 5.1. Composition:—

Sulphur	26·3
Copper	38·6
Antimony	16·5
Arsenic	7·2

together with some iron, zinc, and silver, amounting to 15 per cent. It sometimes contains 30 per cent. of silver, in place of part of the copper, and is then called *Argentiferous Gray Copper Ore*, or *Silver Fahlerz.* The amount of arsenic varies from 0 to 10 per cent. One variety from Spain included 10 per cent. of platinum, and another from Hohenstein some gold; another from Tuscany 2·7 per cent. of mercury. These varieties give off before the blow-pipe fumes of arsenic and antimony, and after roasting yield a globule of copper. It dissolves, when pulverised, in nitric acid, affording a brownish-green solution. Its copper-reactions before the blow-pipe, and in solution in nitric acid, distinguish it from the gray silver ores. The Cornish mines, Andreasberg in the Harz, Kremnitz in Hungary, Freiberg in Saxony, Kapnik in Transylvania, and Dillenberg in Nassau, afford fine crystallisations of this ore. It is a common ore in the Chilian mines, and is worked there and elsewhere for copper, and often also for silver.

Red Copper Ore.—Monometric. In regular octahedrons, and modified forms of the same. Cleavage octahedral. Also massive, and sometimes earthy. Colour deep red, of various shades; streak brownish-red. Lustre adamantine, or sub-metallic; also earthy, sub-transparent to nearly opaque. Brittle. Hardness, 3·5 to 4. Specific Gravity, 6. Composition:—

Copper	88·88
Oxygen	12

Before the blow-pipe on charcoal it yields a globule of copper. It dissolves in nitric acid. The earthy varieties have been called *Tile Ore*, from the colour. From cinnabar it differs in not being volatile before the blow-pipe, and from red iron ore in yielding a bead of copper on charcoal, and copper-reactions. It occurs with other copper ores in the Bannat, Thuringia, Cornwall, at Chessy, near Lyon; in Siberia, and Brazil; also in the United States. The octahedrons are often green, forming a coating of malachite.

Black Copper. Tenorite.—An oxide of copper occurring as a black powder and in dull black masses and botryoidal concretions, in veins or along with other copper ores. From Cornwall, and also the Vesuvian lavas. It is an abundant ore in some of the copper mines of the Mississippi Valley, and yields 60 to 70 per cent. of copper. The oxides of copper are easily smelted by heating with the aid of charcoal alone. They may be converted directly into sulphate or blue vitriol by means of sulphuric acid, but are more valuable for the copper they afford.

Blue Vitriol. Sulphate of Copper. Copperas.—Triclinate. In oblique rhomboidal prisms; also as an efflorescence or incrustation. Colour deep sky-blue; streak uncoloured. Sub-transparent to translucent. Lustre vitreous. Soluble. Taste nauseous and metallic. Hardness, 2 to 2·5. Specific Gravity, 2·21. Composition:—

Sulphuric Acid	31·7
Oxide of Copper	32·1
Water	36.2

A polished plate of iron in a solution becomes covered with copper. It occurs with the sulphurets of copper as a result of their decomposition, and is often in solution in the waters flowing from copper mines. Occurs in the Harz, at Fahlun in Sweden, and in many other copper regions.

Blue Vitriol is much used in dyeing operations, and in the printing of cotton and linen; also for various other purposes in the arts. It has been employed to prevent dry rot by steeping wood in its solution, and is a powerful preservative of animal substances; when imbued with it and dried they remain unaltered. It is afforded by the decomposition of copper pyrites, in the same manner as green vitriol from iron pyrites. It is manufactured for the arts from old copper sheathing, copper turnings, and copper refinery scales. The scales are readily dissolved in dilute sulphuric acid at the temperature of ebullition; the solution obtained is evaporated to the point where crystallisation will take place on cooling. Metallic copper is exposed in hot rooms to the atmosphere after it has been wetted in weak sulphuric acid. By alternate wetting and exposure it is rapidly corroded, and affords a solution which is evaporated for crystals. 400,000lbs. is the annual consumption of blue vitriol in the United States. In some mines the solution of sulphate of copper is so abundant as to afford considerable copper, which is obtained by immersing clean iron in it. It is called Copper of Cementation. At the copper springs of Wicklow, Ireland, about 500 tons of iron were laid at one time in the pits: in about twelve months the bars were dissolved, and every ton of iron yielded a ton and a half, and sometimes nearly two tons, of a precipitated reddish mud, each ton of which produced 16 cwt. of pure copper. The Rio Tinto mine, in Spain, is another instance of working the sulphate in solution. These waters yield annually 1800 cwt. of copper, and consume 2400 cwt. of iron.

Green Malachite. Green Carbonate of Copper.—Monoclinate. Usual in incrustations, with a smooth tuberose botryoidal or stalactitic surface. Structure finely and firmly fibrous; also earthy. Colour light green; streak paler. Usually nearly opaque. Crystals translucent. Lustre of crystals adamantine, inclining to vitreous; but fibrous incrustations silky, on a cross fracture. Earthy varieties dull. Hardness, 3·5 to 4. Specific Gravity, 4. Composition:—

Carbonic Acid	18
Oxide of Copper	70·5
Water	11·5

Dissolves with effervescence in nitric acid. Decrepitates and blackens before the blow-pipe, and becomes partly a black scoria. With borax it fuses to a deep green globule, and ultimately affords a bead of copper. It is readily distinguished by its copper-green colour and its association with copper ores. It resembles a siliceous ore of copper, *Chrysocolla*, a common ore in the mines of the Mississippi valley; but it is distinguished by its complete solution and effervescence in nitric acid. The colour also is not the bluish-green of chrysocolla. Green malachite usually accompanies other ores of copper, and forms incrustations, which when thick have the colours blended, and extremely delicate in their shades and blending. Perfect crystals are quite rare. The mines of Siberia, at Nischne Tagilsk have afforded great quantities of this ore. A mass partly disclosed measured at top 9 feet by 18 feet; and the portion uncovered contained at least half a million pounds of pure malachite. Other noted localities are Chessy in France, Sandlodge in Shetland, Schwartz in the Tyrol, Cornwall, Australia, and the island of Cuba. This mineral receives a high polish, and is used for inlaid work, and also ear-rings, snuff-boxes, and various ornamental articles. It is not much prized in jewellery. Very large masses are occasionally obtained in Russia, which are worked into slabs for tables, mantel-pieces, and vases, which are of exquisite beauty, owing to the delicate shadings and radiations of colour. In the Great Exhibition of 1851 there were magnificent specimens of this material in the shape of doors and vases sent thither by the Emperor of Russia. At Versailles there is a room furnished entirely with tables, chairs, &c., wrought in malachite, and the same are to be found in other European palaces. At Nischne Tagilsk, a block of malachite was obtained weighing 40 tons. Malachite is sometimes passed off in jewellery as turquoise, though easily distinguished by its shade of colour and much inferior hardness. It is a valuable ore when abundant, but it is seldom smelted alone, because the metal is liable to escape with the liberated volatile ingredient, carbonic acid.

Azurite. Blue Carbonate of Copper.—Monoclinate. In modified oblique rhombic prisms, the crystals rather short and stout; lateral cleavage perfect; also massive; often earthy. Colour deep blue, azure, or Berlin blue; transparent to nearly opaque; streak bluish.

Lustre vitreous, almost adamantine. Brittle. Hardness, 3·5 to 4·5. Specific Gravity, 3·5 to 3·85. Composition :—

Carbonic Acid	25·5
Oxide of Copper	69·1
Water	5·5

Before the blow-pipe and in acids it acts like the preceding. Azurite accompanies other ores of copper. At Chessy in France its crystallisations are very splendid. It is found also in Siberia, in the Bannat, and near Redruth in Cornwall. As incrustations, and rarely as crystals, it occurs near Singsing, New York; also in other parts of the United States.

When abundant it is a valuable ore of copper. It makes a poor pigment, as it is liable to turn green.

Chrysocolla. Silicate of Copper.—Usually as incrustations; botryoidal and massive; also in thin seams and stains; no fibrous structure apparent, nor any appearance of crystallisation. Colour bright green, bluish-green. Lustre of surface of incrustations smoothly shining; also earthy. Translucent to opaque. Hardness, 2 to 3. Specific Gravity, 2 to 2·3. Composition :—

Oxide of Copper	40·0
Silica	36·5
Water	20·2
Carbonic Acid	2·1
Oxide of Iron	1·0

This mineral varies much in the proportion of its constituents, as it is not crystallised. It blackens in the inner flame of the blow-pipe without melting. With borax it is partly reduced. No effervescence nor complete solution in nitric acid, cold or heated.

It is distinguished from green malachite, as stated under that species. It accompanies other copper ores in Cornwall, Hungary, the Tyrol, Siberia, Thuringia, &c. In Chili it is abundant at the various mines. In Wisconsin and Missouri it is so abundant as to be worked for copper. It was formerly taken for green malachite. This ore in the pure state affords 30 per cent. of copper, but as it occurs in the rock will hardly yield one-third of this amount. Still, when abundant, as it appears to be in the Mississippi valley, it is a valuable ore. It is easy of reduction by means of limestone as a flux.

Dioptase is another silicate of copper, occurring in rhombohedral crystals and hexagonal prisms. Colour emerald green. Lustre vitreous; streak greenish. Transparent to nearly opaque. Hardness, 5. Specific Gravity, 3·28. From the Kirghese Steppes of Siberia.

Besides the above salts of copper, the following species, which are of little use in the arts, are given in Dana's 'Manual of Mineralogy':—

Arsenates of Copper.

Euchroite has a bright emerald-green colour, and contains 33 per cent. of arsenic acid and 48 per cent. of oxide of copper. Occurs in modified rhombic prisms. Hardness, 3·75. Specific Gravity, 3·4. From Lebethen in Hungary.

Aphanesite is of a dark verdegris-green inclining to blue, and also dark blue. Hardness, 2·5 to 3. Sp. Gr., 4·19. It contains 30 per cent. of arsenic acid and 54 per cent. of oxide of copper. From Cornwall.

Erinite has an emerald-green colour, and occurs in mammillated coatings. Hardness, 4·5 to 5. Sp. Gr., 4·04. Contains 33·8 per cent. of arsenic acid and 59·4 per cent. of oxide of copper. From Limerick, Ireland.

Lirioconite varies from sky-blue to verdigris-green. It occurs in rhombic prisms sometimes an inch broad. Hardness, 2·5. Sp. Gr., 2·8 to 2·9. Contains 14 per cent. of arsenic acid and 49 per cent. of oxide of copper.

Olivenite presents olive-green to brownish colours, and occurs in prismatic crystals or velvety coatings. Hardness, 3. Sp. Gr., 4·2. Contains 36·7 per cent. of arsenic acid and 56·4 per cent. of oxide of copper.

Copper Mica is remarkable for its thin foliated or mica-like structure. The colour is emerald or grass-green. Hardness, 2. Sp. Gr., 2·55. It contains 21 per cent. of arsenic acid, 58 per cent. of oxide of copper, and 21 per cent. of water. From Cornwall and Hungary.

Copper Froth is another arsenate of a pale apple-green and verdigris-green colour. It has a perfect cleavage. It contains 25 per cent. of arsenic acid, 43·9 of oxide of copper, 17·5 of water, and 13·6 of carbonate of lime. From Hungary, Siberia, the Tyrol, and Derbyshire.

Condurrite has a brownish-black or blue colour. From Cornwall.

These different arsenates of copper give an alliaceous odour when heated on charcoal before the blow-pipe.

Phosphates of Copper.

Pseudo-Malachite occurs in very oblique crystals or massive and incrusting, and has an emerald or blackish-green colour. Hardness, 4·5 to 5. Sp. Gr., 4·2. Contains 68 per cent. of oxide of copper. From near Bonn on the Rhine, and also from Hungary.

Libethenite has a dark or olive-green colour, and occurs in prismatic crystals and massive. Hardness, 4. Sp. Gr., 3·6 to 3·8. Contains 64 per cent. of oxide of copper. From Hungary and Cornwall.

Thrombolite is a green phosphate occurring massive in Hungary. Contains 39 per cent. of oxide of copper.

These phosphates give no fumes before the blow-pipe, and have the reaction of phosphoric acid.

Chlorides of Copper.

Atacamite.—Colour green to blackish-green. Lustre adamantine to vitreous; streak apple-green. Translucent to sub-translucent. Occurs in right rhombic prisms and rectangular octahedrons; also massive. Consists of oxide of copper 76·6, muriatic acid 10·6, water 12·8. Gives off fumes of muriatic acid before the blow-pipe, and leaves a globule of copper. From the Atacama Desert between Chili and Peru, and elsewhere in Chili; also from Vesuvius and Saxony. It is ground up in Chili, and sold as a powder for letters under the name of Arsenillo.

A Sulphate Chloride of Copper has been observed in Cornwall, in blue acicular crystals, apparently hexagonal.

Beaumontite of C. T. Jackson is a hydrous crenato-silicate of copper, containing 15·8 per cent. of crenic acid. It is bluish-green to greenish-white, and pulverulent when dry. From Chessy, France.

Vanadate of Copper.—Massive and foliated or pulverulent; folia citron-yellow, pearly. From the Ural.

Buratite.—A hydrous carbonate of copper, zinc, and lime, occurring in bluish radiating needles. Sp. Gr., 3·2. From Chessy, France; the Altaï Mountains; and Tuscany.

Velvet Copper Ore. — In velvety druses or coatings, consisting of short fine fibrous crystallisations. Colour, fine smalt blue.

Copper has been known since the earliest periods. It is obtained for the arts mostly from pyritous copper—the gray sulphurets and the carbonate; also to some extent from the black oxide and from solutions of the sulphate. The principal copper mines in the world are those of Cornwall and Devon in England; of the island of Cuba; of Copiapo and other places in Chili; Chessy, near Lyon, in France; in the Erzgebirge, in Saxony; at Eisleben and Sangerhausen, in Prussia; at Goslar, in the Lower Harz; at Schemnitz, Kremnitz, Kapnik, and the Bannat, in Hungary; at Fahlun, in Sweden; at Turmsk, Nischne Tagilsk, and other places in the Urals; also in China and Japan. Lately extensive mines have been opened in Southern Australia. Copper, united with zinc in different proportions, forms brass and pinchbeck. Bronze is an alloy of copper with 7 to 10 per cent. of tin. This is the material used for cannon. With 8 per cent. of tin it is the bronze used for medals. With 20 per cent. of tin, the material for cymbals. Bell-metal is composed of copper with a third to a fifth as much tin by weight. Sheet-copper is made by heating the copper in a furnace, and rolling it between iron rollers. Copper is also worked by forging and casting. In casting, it will not bear over a red heat without burning.

(We are indebted for the substance of this article to Dana's excellent 'Manual of Mineralogy.')

COPPER, ORES OF. [COPPER.]

COPPERAS. [COPPER.]

COPROLITES (κόπρος and λίθος), the fossilised excrements of reptiles, fish, and other animals, found in various strata of the earth. Dr. Buckland in his 'Bridgewater Treatise' first drew attention to the probable nature of these substances, some of which had been previously known under the name of Bezoar Stones. These fossils were first detected in the Lias at Lyme Regis and in other localities, and their true nature inferred from the fact of their identity with similar masses found actually within the body of many species of *Ichthyosaurus*. The *Coprolites* are often found to contain scales of fishes, and occasionally teeth, and fragments of bone, belonging to species of fishes and reptiles which have been swallowed by the animal as food, and have passed undigested through its stomach. They often occur in a spirally twisted form, which is a characteristic of the excrements of some of the larger forms of recent fish, and have been accepted by comparative anatomists as indications of the nature of the intestinal tube in the extinct forms of Reptiles and Fishes.

Professor Liebig says in his 'Letters on Chemistry,' "In the autumn of 1842 Dr. Buckland pointed out to me a bed of Coprolites in the neighbourhood of Clifton, from half to one foot thick, inclosed in a limestone formation, extending as a brown stripe in the rocks for miles along the banks of the Severn. The limestone marl of Lyme Regis consists for the most part of one fourth part of fossil excrements and bones. The same are abundant in the Lias of Batheaston, and Broadway Hill, near Evesham. Dr. Buckland mentions beds several miles in extent, the substance of which consists in many places of a fourth part of Coprolites."

Coprolites, when chemically examined, are found to contain a large proportion of phosphate of lime. Liebig states that some he examined from Clifton contained above 18 per cent. of phosphate of lime, whilst other specimens have afforded a much larger per centage. The occurrence of phosphate of lime in these substances has led to their use as manures, and large quantities are annually collected in this country for that purpose. Before being used they are submitted to the action of sulphuric acid, by which the phosphate is converted into a super-phosphate of lime. [MANURE, in ARTS AND SC. DIV.]

Not only have the beds of the Lias afforded deposits of phosphate of lime which have received the name of *Coprolites*, but they have also been found in the Greensand, in the Wealden Formation, and in the Red Crag. In the latter formation it may be altogether doubted as to whether the phosphate of lime there found in the form of dark-brown or blackish smooth nodules, can be appropriately called Coprolites. These nodules occur in beds or seams running through the Red Crag of Suffolk, where, in the neighbourhood of Ipswich and

Woodbridge, and on the sea-coast of Felixstow and Bawdsey, it is worked to a considerable extent. In addition to these nodules, are found the fragments of the bones of various forms of *Cetaceæ*, all of which contain large quantities of phosphate of lime, and are collected under the name of Coprolites. It is still a question of interest as to how the nodules not having an organic basis have been formed. It has been supposed that all deposits of phosphate of lime are derived from the destruction of organised beings, but it is very evident that phosphate of lime must have existed in some form or another before the creation of either vegetable or animal beings. The increase also of the number of individuals of species of plants and animals demand that there should be some constant supply of this substance from the mineral kingdom. Whatever may be the result of further inquiry on this point, there can be little doubt of the impropriety of calling all deposits of phosphate of lime Coprolites. A better general name and which is not exposed to the objection of a false theory would be *Phosphatite*. [PHOSPHATITE.]

COPROPHAGI. [SCARABÆIDES.]

COPTIS (from κόπτω, to cut), a genus of Plants belonging to the natural order *Ranunculaceæ*. It has 5-6 sepals, coloured, petaloid, deciduous; the petals small, cucullate; the stamens 20-25; the capsules 6-10, on long stalks, somewhat stellate, membranous, ovate, oblong, tipped with the style; 4-6 seeded.

C. trifolia, Gold Thread, has ternate leaves, obovate blunt toothed hardly 3-lobed leaflets; the scape 1-flowered. It is a native of Iceland, Norway, Greenland, Siberia, and Kamtchatka, in swampy woods, and also of the cedar-swamps of North America, from Canada to Virginia. It is a small plant with white flowers and a yellow fibrous rhizoma which runs in all directions. The French in Canada call it Tissavoyanne jaune. A decoction of the leaves and stalks is used by the Indians for giving a yellow colour to cloth and skins. The rhizomata are bitter, and when administered as a medicine act in the same manner as quassia, gentian, and other bitters, but are not astringent; it is a popular remedy in the United States for aphthous affections of the mouth in children.

C. asplenifolia has biternate leaves, the leaflets rather pinnatifid, very acutely serrated, the scape 2-flowered. It is a native of Japan and the north-west coast of America.

Both species are pretty plants, and will thrive in a peat soil. A moist situation agrees with them, or they may be planted in pots among alpine plants. They may be propagated by seed, or by dividing the roots.

(Don, *Dichlamydeous Plants*; Lindley, *Flora Medica*.)

CORACES. [CORACIAS.]

CORACIAS, a genus of Birds belonging to the Insessorial or Perching division.

Linnæus arranged the genus *Coracias* between *Corvus* and *Oriolus*. Pennant ('British Zoology') gives it a position between the Nut-Cracker and the Oriole; M. Duméril placed it between the Birds of Paradise and the Crows; and Meyer arranged it in his second order, *Coraces*, among which it stands in Illiger's method. Cuvier placed the Rollers (*Coracias*, Linn.) between the Crows (*Corvus*, Linn.) and the Birds of Paradise (*Paradisea*, Linn.), the position assigned to them by Lacépède; and includes under that title the Rollers properly so called (*Coracias garrula*, Linn. &c.), and the Rolles (*Colaris*).

Mr. Vigors places them in his family *Corvidæ*. [CORVIDÆ.]

M. Lesson's family *Eurystomidæ* (Rolliers of Cuv.) consists of the Rollers (*Galgulus*, Brisson, and *Coracias*, Linn.); the genus Rolle (*Eurystomus*, Vieill. [MEROPIDÆ], *Colaris*, Cuv., *Coracias*, Linn.); the genus *Mainatus* (*Eulabes*, Cuv., *Gracula*, Linn.); and the genus *Mino*, Less. M. Lesson rejects the term *Coracias*, because many authors have so dismembered it, according to their different views, that a confusion calculated to produce error is the result.

In the system of Mr. Swainson, who retains the generic name *Coracias*, the Rollers appear among the *Meropidæ*. [MEROPIDÆ.]

The Prince of Canino arranges the genus *Coracias*, giving as an example the common Roller, (*C. garrula*, Linn.) in the family *Ampelidæ*. ('Birds of Europe and North America.')

In Mr. Gould's great work on the 'Birds of Europe,' the Roller (*C. garrula*) comes down between the Bee-Eater (*Merops apiaster*) and Kingfisher (*Alcedo aspida*).

Mr. Yarrell ('British Birds') arranges the common Roller under the family *Meropidæ*.

C. garrula, the Roller. It is the Pica Marina and Pica Merdaria of the Italians; Rollier of the French; Birk-Heher, Blaue-Racke, and Mandelkrahe, of the Germans; Spransk Kraka, Blakraka, and Allekraka, of the Swedes; Ellekrage of Brunich; and Rholydd of the Welsh. The bill is black towards the point, becoming brown at the base with a few bristles; irides of two circles yellow and brown; head, neck, breast, and belly various shades of verditer-blue changing to pale green; shoulders azure-blue, back reddish-brown, rump purple, wing-primaries dark bluish-black, edge lighter, tail-feathers pale greenish-blue, the outer ones tipped with black, those in the middle also much darker in colour; legs reddish-brown; in old males the outer tail-feathers are somewhat elongated.

Adult females differ but little from the males; young birds do not attain their brilliant colour till the second year. (Gould, 'Birds of Europe.') Length about 13 inches.

This bird appears to have a wide geographical range. In Europe, it is found in Denmark, Sweden (where it arrives with the Cuckoo), and the southern provinces of Russia; is more common in Germany than France, where however it has been found in Provence; and it has been taken at Gibraltar. In Italy, according to Prince Bonaparte, it is rather common, arriving in the spring and departing in September. In Malta and Sicily it is exposed for sale in the shops of poulterers, and is said to have the taste of a turtle-dove. In the Morea it is considered a delicacy in the autumn, when it is fat with its summer food. It has been captured at Aleppo, and at Trebizond and Erzerum. It visits the countries between the Black and the Caspian seas; and Dr. von Siebold and M. Bürger include it among the birds of Japan. In North Africa it is found from Marocco to Egypt. Flocks were seen by Adanson at Senegal, and he concluded that they passed the winter there. Dr. Andrew Smith records it among the birds of South Africa. In Great Britain it has been killed in Cornwall, in Suffolk, and Norfolk, in Cambridgeshire, in Yorkshire, Northumberland, Perthshire, the east of Scotland, and Orkney. It has been only occasionally seen in Ireland.

The Roller (*Coracias garrula*).

Deep forests of oak and birch appear to be the favourite haunts of the Roller. In the 'Annals of Natural History' for 1839, it is stated by a traveller in Asia Minor, that the Roller, which was most common throughout the south and west parts of the country wherever the magpie was not found (for it was not seen in the same district with that bird), was observed to fall through the air like a Tumbler Pigeon. Temminck states that it makes its nest in the holes of trees, where it lays from four to seven eggs of a lustrous white. M. Vieillot states that in Malta, where trees are scarce, the bird builds on the ground. In Barbary it has been observed to form its nest in the banks of the Sheliff, Booberak, and other rivers; and Pennant remarks that where trees are wanting, it makes it in clayey banks. These last modes of nidification bring it very close to the Bee-Eaters and Kingfishers, whose eggs quite resemble those of the Roller in colour and shape, and only vary in size. The male takes his turn to sit. The food is very varied, according to Temminck, who enumerates moles, crickets, cockchafers, grasshoppers, millipedes, and other insects, slugs, and worms. Gould states that it feeds on worms, slugs, and insects generally. Yarrell informs us that the food consists of worms, slugs, insects in their various stages, and berries.

Bechstein observes that till lately he had thought that the Roller was untameable; but Dr. Meyer of Offenbach had convinced him to the contrary, having himself reared them in his room by the following method:—The young ones must be taken from the nest when only half grown, and fed on little bits of cow's-heart or any other meat which is lean and tender, till they can feed alone; small frogs, worms, and insects may then be added. Its mode of killing and swallowing insects is thus described: it commences by seizing and crushing them with its bill, and then throws them into the air several times, in order to receive them in its throat, which is very capacious. When the morsel is too large, or the insect is still alive, the bird strikes it hard against the ground, and begins again to throw it into the air till it falls not across, but so as to thread the throat, when it is easily swallowed. Bechstein says that he had never seen the bird drink. The translator of Bechstein's interesting little book states, that he once saw a Roller drink after having swallowed dry ants'-eggs; it then ate greedily of lettuce and endive. "Another which I kept," adds the translator, "liked the outside of lettuces and spinach after having eaten insects, especially beetles, which are very heating. To judge from what I have observed, the Roller is by nature wild and solitary; it seldom changes its situation except to seek its food or to hide itself from strangers. It is a good thing, whether kept in a cage or let range, always to have a box in its way, in which it may take refuge when frightened; it will not fail to hide itself there, and by this means will not be tempted to beat itself violently, which it does when it cannot fly from the object of its fright. It knows its mistress very well, lets her take it up, comes near her, and sits without any fear on her knees for whole hours without stirring. This is as far as it goes even when tamed. It is neither caressing nor familiar: when frightened it utters harsh cries, softer ones when its food is brought; but 'crag, crag, craag,' at the same time raising its head, is the expression of its joy or triumph."

Gracula religiosa (Linnæus), the Mino-Bird, is the Bëo and Meucho of the Javanese, Tecong of the Sumatrans, and is referred by Mr. Swainson to the *Sturnidæ*. Mr. G. R. Gray arranges it under the family *Corvidæ*, in the sub-family *Graculinæ*. Mr. Swainson states that analysis has convinced him that neither the Rollers nor the bird in question belong to the *Corvidæ*; and he remarks that the little value that can be attached to speculations on the rank of the present genera founded upon mere synthesis, will best appear by looking to those artificial arrangements that place the short-legged Rollers close to the long-legged and powerfully-constructed Grakle (*Gracula religiosa*). M. Lesson places this bird next to the Rollers, and among the *Eurystomidæ*.

Mino-Bird (*Gracula religiosa*). (*Eulabes Javanus*, Vieill.)

It is the type of Cuvier's genus *Eulabes*, which has the following characters:—Bill short, stout, not so long as the head; entirely compressed. Frontal feathers advancing far upon the base, but not dividing the front. Culmen gradually curved from the base to the tip, which is distinctly notched. Commissure but slightly angulated. Under mandible with the base broad and dilated. Nostrils basal, naked, round, sunk in a depression. Frontal feathers short, velvety. Head with naked wattles. Wings as in Pastor. Tail short, even. Feet rather short, very strong. Tarsus and middle toe equal; hinder toe shorter; inner toe almost equal to the outer toe. (Sw.)

Its colour is of a deep velvety black; a white space in the middle of the wing; bill and feet yellow; behind the eye spring fleshy caruncles of a bright orange-colour, and extend beyond the occiput.

It is found in Java, Sumatra, and the great Eastern Islands.

Insects and fruits form the food of the Mino-Bird, which is easily tamed, and learns to whistle and talk with great facility. With the natives it is a great favourite in consequence. Marsden says of it, that it has the faculty of imitating human speech in greater perfection than any other of the feathered tribe. Bontius, who terms it *Pica, seu potius Sturnus Indicus*, heads the chapter where he figures and describes it, with the following lines:—

"Psittacus Eois quamvis tibi missus ab oris
Jussa loquar; vincit me Sturnus garrulus Indus."—

And tells the following story:—There was, when he was in Batavia, an old Javanese woman, the servant of a Chinese gardener, who kept one of these birds, which was very loquacious. Bontius was very anxious to buy it, but this the old woman would not hear of. He then begged that she would at least lend it to him that its picture might be taken, a request which was at last granted with no very good grace, the ancient Mohammedan dame being under great apprehension that Bontius would offer that abomination, pork, to her beloved bird. This he promised not to do, and had the loan of the Mino, which kept continually saying "Orang Nasarani Catjor Macan Babi." This, being interpreted, means "Christian Dog, Eater of Pork;" and Bontius came to the conclusion that the unwillingness of the old woman arose not only from the fear of her bird being desecrated by an offer of swine's flesh, but also from the apprehension that he or his servants, irritated by its contumelies, would wring its neck. M. Lesson also saw one at Java which knew whole phrases of the Malay language.

The general opinion seems to be that there is but one species of Mino-Bird.

Cuvier however states that Linnæus confounded two species under the name of *Gracula religiosa*, namely, *Eulabes Indicus* and *Eulabes Javanus*.

M. Lesson, who states that only one species is known, namely, the Mainate Religieux, *Gracula religiosa*, Linn., Bëo and Meucho of the Javanese, remarks afterwards that there is said to be a smaller variety: this is probably the *Eulabes Indicus* above noticed.

Eulabes Indicus.

The last-mentioned ornithologist applies the old Indian word Mino as a generic term for a very different bird, *Mino Dumontii*, described by him in the 'Zoology of the Coquille,' and there figured at pl. 26. He is also of opinion that *Gracula calva*, Linn., should be added to this genus.

CORA'CINA, a genus of Birds, separated from the Crows (*Corvidæ*) by Vieillot, and divided by him into four sections. The first comprises those species which have the bill furnished at its base with velvety feathers (Les Col-Nus, 'naked necks'); the second those whose nostrils are covered with setaceous feathers, directed forwards, and whose upper mandible is notched towards the end (Les Choucaris, *Graucalus*); the third those whose bill is naked at the base, and notched at the point (*Coracina gymnocephala*, Vieillot; *Corvus calvus*, Latham, for example); and the fourth, that curious species on which Geoffroy-Saint-Hilaire founded his genus *Cephalopterus*.

Cuvier, in the last edition of the 'Règne Animal,' defines *Graucalus* to be the Greek name of an ash-coloured bird (oiseau cendré), and says that three Choucaris out of four are of that colour. M. Vieillot, he adds, confounds these birds with his *Coracinæ*, which comprise the *Gymnoderi* and the *Gymnocephali*.

M. Lesson, who places the group under the *Ampelidæ*, observes that the genus *Coracina* is far from being determined. Thus, he observes, M. Vieillot places under it the *Cephalopterus* of M. Geoffroy-Saint-Hilaire, the Choucaris and the Col-Nu, or *Gymnoderus*. (He might have added the *Gymnocephalus* of Geoffroy and Cuvier.) Temminck adds to it many of the *Cotingas* of Le Vaillant; but for his own (Lesson's) part, he adopts the term *Coracina* for that group of birds which Cuvier has collected together under the name of Piauhaus.

Coracina, Lesson (*Coracina*, Temminck; Les Piauhaus, *Cotinga*, Cuvier; Piauhau, *Querula*, Vieillot).—Bill depressed, smooth, ciliated at the base, thick, narrowed at the point, angular above, a little curved towards the end, slightly toothed at the point; lower mandible a little flattened below; head and neck feathered, but without any ornamental plumes, and without any naked skin.

C. scutata, Temminck and Latham. This species differs but little from *Coracina rubricollis*, *Muscicapa rubricollis*, of Gmelin, in the colour of its plumage, but the wings are shorter. In *C. rubricollis* the plumage is all black, with the exception of the throat and front of the neck, which are of a purpled rose-colour. In *C. scutata*, the red, which covers the throat and breast, goes as low as the upper part of the belly, and the bill is not black as it is in *C. rubricollis*. It is found in Brazil, which is also the habitat of *C. rubricollis*.

Gymnocephalus (*Coracina*, Vieillot).—M. Lesson observes that Messrs. Vieillot and Temminck place the *Gymnocephali* (Bald-Heads) among the *Coracinæ*, and that Cuvier contents himself with observing that *Corvus calvus*, Latham, the type of this new genus, has the bill of the Tyrants, with the ridge (culmen) a little more arched, and a great portion of the face denuded of feathers. Le Vaillant, he states, regarded this denudation of the skin in the front of the head as the

Coracina scutata.

result of a particular habit; and in the 'History of the Birds of Paradise' has printed a note, in which he affirms that he had received from Cayenne a specimen having this part well covered with feathers; but M. Lesson adds that he himself had seen at Rochefort more than twenty skins of *Gymnocephali*, and that all had the face bare of feathers. However it may be, he continues, this genus entirely requires revision.

G. calvus, the Capuchin Baldhead. It is the *Coracina gymnocephala*, Vieillot; *Corvus calvus*, Latham. Size of the crow; and of the colour of Spanish snuff, or, as some authors write it, Capuchin colour, whence the Creoles of Cayenne give it the name of Oiseau mon Père. The quills and the tail-feathers are black. The large beak and ample forehead bare of feathers give a singular air to this bird. Vieillot observes that it has been compared to the rook, on account of the nakedness of the head, a comparison which seems to him just; "for," says Vieillot, "it has not this part naked till it is adult, the young, like the young rook, having the head entirely feathered, and even the

Capuchin Baldhead (*Gymnocephalus calvus*).

nostrils covered with small setaceous feathers, as I can testify, from the inspection of a young individual of which I have made mention in the first edition of the 'Nouveau Dictionnaire d'Histoire Naturelle.'" It is a native of Guyana.

Gymnoderus (*Coracina*, Vieillot, Temminck; *Cotinga*, Le Vaillant).—The principal characters of *Gymnoderus*, Geoffroy-Saint-Hilaire, rest on the possession of a bill like that of the *Coracinæ* and *Cephalopteri*, with a partially naked neck and a head covered with velvety feathers.

G. fœtidus. It is *Coracina gymnodera*, Vieillot; *Corvus nudus*, Latham; *Gracula nudicollis*, Shaw; *Gracula fœtida*, Linnæus; Col-Nu, Buffon. Rather larger than the jackdaw, but the body is thick and fleshy. The sides of the neck are entirely naked, and only present some traces of down. Buffon's figure, on the contrary (Planches Enlum. 609), represents this part as being clothed with a considerably thick down. Upper part of the head, back of the neck and throat, covered with small close-set feathers like black velvet. External edges of the quills of the middle of the wing, the last quills, and all the wing-coverts, bluish-gray. Great quills and tail-feathers black, with bluish reflections. The rest of the plumage, bill, and feet, black. Eyes red brown, with a yellow skin beneath. The female is smaller, and of a brownish black. It is a native of Brazil and Guyana.

Gymnoderus fœtidus, male.

Cephalopterus.—Bill strong, robust; mandibles nearly equal, the upper one convex and scarcely curved at the summit, not notched at the point; lower mandible flattened below. Nostrils longitudinal, open, hollowed into an oval excavation; bristles at the border of the bill, which infringe a little on the frontal feathers. Two rows of feathers, taking their origin on the forehead, and elevating themselves into a plume or crest on the head. The feathers of the neck form a kind of pendent pelerine in front of the neck, which is naked.

C. ornatus. It is the *Coracina cephaloptera* of Vieillot. Colour a

Cephalopterus ornatus.

uniform blue black. Head and base of the bill ornamented with a plume or crest, forming a sort of parasol, composed of straight elevated feathers, with white and stiff shafts, and terminated by an ear (épi) of black beards, which projects forwards (se renverse en devant). The sides of the neck are naked, but long feathers forming a loose pelerine, and hanging down lower than the breast, spring from beneath the throat and from the sides of the neck. Tail long, slightly rounded. General plumage of a deep black. Crest and feathers of the pelerine giving metallic reflections. (Lesson.)

The bird that furnished the description was brought to M. Geoffroy-Saint-Hilaire from Lisbon. M. Lesson states that the belief was that it came from Brazil, but that a well-informed Portuguese had told him that it was from Goa. M. Vieillot says that the colour of the naked skin of the neck is cerulean blue. Mr. Swainson, in his 'Natural History and Classification of Birds,' London, 1836, says:—"The crest of this extraordinary bird is immensely large, advancing so far in front as to touch the end of the bill, and it is compressed in the same manner as that of *Rupicola;* but the ends of the feathers, instead of meeting so as to form a sharp ridge, suddenly recede from each other, curve outwards, and form a most elegant drooping line of plumes, hanging over on the sides so as to shade the face like an umbrella. The figures that have hitherto been given of this rare bird are all taken from the specimen in the Paris Museum, and which has been sadly distorted in the setting up. A minute examination of this specimen has convinced us that the frontal feathers, instead of being raised over the bill, as Temminck represents them, partly repose and overshadow it, at least as much as do those of *Calyptomena* and *Rupicola*" (vol. i. p. 41). The species above noticed is the only one known.

CORACITE (Le Conte), an ore resembling *Pitchblende* [PITCHBLENDE], in which oxide of aluminium supplants a part of the oxide of uranium contained in that mineral. It is found on the north shore of Lake Superior in a vein two inches wide, near the junction of trap and syenite. It occurs massive with a resinous lustre, and has a hardness of 4·5, and a specific gravity of 4·38.

CORAL. [POLYPIFERA.]

CORAL RAG, the most calcareous or at least most coralliferous part of the Oxford Oolite Formation. It is a variable and singular rock, most rich in *Madrephylliæa* and *Echinodermata,* in the vicinity of Calne.

CORALLINA. [CORALLINACEÆ.]

CORALLINACEÆ, a family of Marine Plants belonging to the order *Algæ.* According to Harvey's definition it includes the *Corallineæ* and *Spongiteæ* of Kützing, and the *Corallinidæ* and *Nulliporidæ* of Dr. Johnston.

The forms referred to this family have been alternately regarded as animals and plants. When their structure was imperfectly understood they were regarded with many of the zoophytes (*Polypifera* and *Polyzoa*) and sponges as sea-weeds. When the animal nature of these beings was established it was again an inference that the Corallines belonged to the animal kingdom. Recent researches have however demonstrated the truly vegetable nature of this family both in their general structure and mode of reproduction. The following is Dr. Harvey's diagnosis in his 'Manual of the British Marine Algæ:'—Rigid, articulated, or crustaceous, mostly calcareous seaweeds, purple when recent, fading on exposure to milk-white. Composed of closely-packed elongated cells or filaments, in which carbonate of lime is deposited in an organised form. Tetraspores tufted, contained in ovate or spherical conceptacles. Ceramidia furnished with a terminal pore.

The following general remarks on this family are taken from Dr. Harvey's work:—The root, where this organ is manifested, is an expanded crustaceous disc, often widely spreading. The frond almost always calcareous, effervescing strongly when thrown into acids, rarely destitute of lime, very variable in aspect and habit. The lowest forms of the order are simple incrustations, spreading like the crustaceous lichens over the surface of rocks, or the fronds of the larger *Algæ.* In the smaller of these the crust is a mere film, as thin as paper, generally circular, and extending by means of small additions to the circumference, so that the frond becomes marked as it advances with concentric circles. In the larger the crust is thick and stony, rising here and there into prominences and sinking into depressions. Still farther advance manifests itself by the crust assuming a branched habit: at first papillæ rise from the surface; these thicken, and widen, and lengthen, and at length throw out branches, till a shrubby frond, of stony hardness, but extremely brittle, is formed. All these changes in character take place within the limits of a single genus, *Melobesia.* Nearly related to this (and by many botanists considered identical) is *Mastophora,* a genus in which the frond is expanded into leafy lobes, usually fan-shaped, sessile, or stalked, but not adnate to rocks; of a flexible substance, containing a smaller portion of carbonate of lime than the former group. Some of these have the habit of *Padina,* but differ from that genus in being of a red colour. They are the most perfectly organised of the leafy or frondose Corallines' (*Milleporeæ*). The articulated or true Corallines are filiform, either pinnated or dichotomous, the branches formed of strings of calcareous articulations, truncated at the upper extremity and rounded at the lower, each articulation connected with that above and below it by a flexible joint composed of cellular tissue, destitute of carbonate of lime. This joint in our British species is scarcely evident till after maceration; but in many exotic species (of *Amphiroa*) it is so long as to interrupt the continuity of the articulations, and is either marked or coated with wart-like calcareous tubercles.

The form of the articulations varies extremely, and often in the same species, or even in the same specimen, so that the determination of these plants is sometimes difficult. In many the articulations are cylindrical, in others oval and compressed, in some flat and irregularly shaped; but in the greater number they are heart-shaped or wedge-shaped, with the upper angles frequently prolonged with horns.

The fructification consists of hollow external or immersed conceptacles containing a tuft of oblong spores, divided at maturity by three horizontal fissures into four parts. They are therefore tetraspores, precisely similar to those of *Plocamium, Hypnea,* &c. The nature of the conceptacle varies even in the same species. Thus in *Corallina* it is normally formed by the metamorphosis of the terminal articulation of the branches, which swells at the sides and becomes pierced at the apex; but in *C. squamata* and even in *C. officinalis* other articulations frequently bear numerous small hemispherical conceptacles on their sides; and sometimes the whole surface is warted with such, and these irregular organs are equally furnished with tetraspores as the normal ones. These latter conceptacles, which are irregular in *Corallina,* are the normal fruit of *Amphiroa,* a genus chiefly from the Southern Ocean. In *Jania* the conceptacle is similar to that of *Corallina,* except that it generally bears a pair of ramuli (resembling the antennæ of an insect) from its upper angles.

The Corallines are found in all parts of the ocean, but are much more numerous in warm than in cold countries, and some of the species of the tropical and sub-tropical ocean are among the most beautiful of marine vegetables. Until recently the plants of this order were with other calcareous *Algæ* confounded with *Zoophytes,* or polypiferous corals. They are however undoubtedly of vegetable nature, and when the lime which they contain is removed by acid, the vegetable framework concealed beneath it is found to be of a similar structure to that of other Rhodosperms, to which group of *Algæ* they are further allied by their colour and the nature of their spores. The order consists of two, or if *Lythocystes* be rightly placed in it, of three sub-orders, as follows:—

Synopsis of the British Genera.

Sub-order 1. *Corallineæ.*—Frond filiform, articulated.

1. *Corallina.*—Frond pinnated. Ceramidia terminal, simple.

2. *Jania.*—Frond dichotomous. Ceramidia tipped with two horn-like ramuli.

Sub-order 2. *Nulliporeæ.*—Frond crustaceous or foliaceous, opaque, not articulated.

3. *Melobesia.*—Frond stony, forming either a crustaceous expansion or a foliaceous or shrub-like body.

4. *Hildenbrandtia.*—Frond cartilaginous, not stony, forming a crustaceous expansion.

Sub-order 3. *Lythocysteæ.*—Frond plane, hyaline, composed of cells radiating from a centre. Fructification unknown.

5. *Lythocystis.*—A minute parasite.

Sub-order 1. *Corallineæ.*

1. *Corallina.*—Frond filiform, articulated, branched (mostly pinnate), coated with a calcareous deposit. Fructification turbinate or obovate, mostly terminal ceramidia, pierced at the apex by a minute spore, and containing a tuft of erect pyriform or club-shaped transversely parted tetraspores. Name from *Corallium,* Coral, which these plants resemble in having a stony substance.

C. officinalis is the most common example of this genus on British shores. It is decompound, pinnate, the lower articulations cylindrical, twice as long as broad, upper slightly obconical, round edged, their angles blunt, ultimate ramuli cylindrical obtuse. It is found on rocks between the tide marks, extending from the limits of high to the extremity of low water mark. Perennial. Winter and spring. The root is a widely expanded red crust. The fronds from two to six inches high, tufted, much branched, bipinnated, but varying greatly in luxuriance according to the depth at which it grows.

C. elongata and *C. squamata* are both British species, and are mentioned in Dr. Johnston's work on the Corallines and also by Dr. Harvey.

2. *Jania.*—Frond filiform, articulated, dichotomous, branched, coated with a calcareous deposit. Fructification urn-shaped. Ceramidia formed of the axillary articulation of the uppermost branches (mostly two-horned), pierced at the apex by a minute pore, and containing a tuft of erect pyriform transversely parted tetraspores. Named from *Janira,* one of the *Nereides.*

J. rubens is found on all parts of the British coast on the smaller *Algæ* between tide marks. The articulations of the principal branches and ramuli are cylindrical, about four times as long as broad. The fronds are from half an inch to two inches high, densely tufted, dichotomous, many times forked, fastigiate; branches either erect or spreading gradually, tapering upwards. Articulations cylindrical in all parts of the frond, without prominent angles; those near the base very short, the upper ones gradually longer. Ceramidia subterminal, urn-shaped with long horns, formed of two to four articulations. Colour a pale red with a purplish shade when quite fresh.

J. corniculata is also found on the southern shores of England and Ireland, and in Jersey.

Sub-order 2. *Nulliporeæ.*

3. *Melobesia.*—Frond attached or free, either flattened, orbicular, sinuated or irregularly lobed, or cylindrical and branched (never articulated), coated with a calcareous deposit; fructification conical, sessile. Ceramidia scattered over the surface of the frond, and containing a tuft of transversely-parted oblong tetraspores. The genus is named from one of the sea nymphs of Hesiod.

M. polymorpha is found attached to rocks, thick, stony, incrusting, or rising into short clumsy branches, which are seldom much divided, and often merely rudimentary. Much is yet to be done in working out the species of this genus.

M. pustulata is the largest and most developed of the parasitic section of the genus. It is found on *Phyllophora rubens*, *Chondrus crispus*, &c. It is thick, of a dull purple or green colour, oblong or lobed, incrusting, smooth. Ceramidia numerous, large, rather prominent, and conical. Dr. Johnston refers this species to *Corallina officinalis*. This plant, he says, appears first in the guise of a circular calcareous patch of a purplish colour, and in this state is common on almost every object that grows between tide-marks. When developing on the leaves of *Zostera*, or in other unfavourable sites, these patches are usually pulverulent and ill-coloured, green or white, and never become large; but in suitable situations they continue enlarging in concentric circles, each marked with a pale zone until they ultimately cover a space of several inches in diameter. The resemblance which in this condition the crust has to some crustaceous fungi, more especially to *Polyporus versicolor*, is remarkably exact; and neither is it less variable than the fungus in its growth, the variations depending on the nature of the site from which it grows. If this is smooth and even, the folliaceous coralline is entirely adnate and also even; but if the surface of the site is uneven or knobbed, the coralline assumes the same character. If it grows from the edge of a rock, or the frond of a narrow sea-weed, or from a branch of the perfect coralline, the basal laminæ spread beyond in overlapping imbrications of considerable neatness and beauty; they are semicircular, wavy, either smooth or studded with scattered granules, and these granules (ceramidia) may be either solid or perforated on the top. Such states of the coralline have been described as *Millepora lichenoides*, while its earlier states constitute Lamoroux's various species of *Melobesia*.

4. *Hildenbrandtia.*—The frond cartilagineo-membranaceous (not stony), crustaceous, suborbicular, adhering by its lower surface; composed of very slender closely-packed vertical filaments; conceptacles immersed in the frond, orbicular, depressed, pierced by a hole, and containing tetraspores and paraphyses at the base of the cavity.

H. rubra is found on smooth stones and pebbles between tide-marks and in deep water. It is very common, and forms a thin membranous crust, at first orbicular, and spreading concentrically, at last irregular in form, following the sinuosities of the body to which it may be attached. Viewed under the microscope, a small portion shows minute cells lying in a clear jelly. When in fruit, the surface is pitted with disc-like depressions, pierced by a hole which communicates with a chamber in which the spores lie. The colour is variable; now a bright, now a dull red.

Sub-order 3. (?) *Lithocysteæ.*

Lithocystis.—Plant calcareous; consisting of a single plane of cellules, which are disposed in radiating dichotomous series, forming an appressed flabelliform frond. Named from a stone in the bladder, because the cells have stony coats.

5. *L. Allmanni* is parasitical on *Chrysymenia clavellosa* from an oyster bed at Malahide, Dublin, by Professor Allmann. It forms minute dot-like patches of a whitish colour on the fronds of the *Chrysymenia*. Each dot consists of one or several fan-shaped fronds composed of quadrate cells disposed in dichotomous series. The plant is brittle, colourless, and effervesces in acid.

(Harvey, *British Algæ.*)

CORALLINES. [CORALLINACEÆ.]

CORALLIUM. [POLYPIFERA.]

CORALLORHI'ZA, a genus of Plants belonging to the natural order *Orchideæ*, and to the tribe *Malaxideæ*. It has a converging perianth; the lips with two prominent longitudinal ridges at the base; 3-lobed, the lateral lobes small, the middle lobe large, slightly emarginate; the spur short or obsolete; the stigma triangular; the rostellum obsolete, but with a large globose appendage; the anthers terminal, 2-celled, opening transversely; the column elongated; the germen slightly stalked, straight.

C. innata has the spur obsolete or wanting. It has thick fleshy roots with much branched fibres. The flowers are seated on a spike, and are of a yellowish colour. It is found in Great Britain in mountainous woods, but is a rare plant. There are several American species. They are exceedingly difficult of cultivation.

CORALWORT. [DENTARIA.]

CORBULA, a genus of Marine *Mollusca*, belonging to the *Lamellibranchiata*. The shell is suborbicular or oval, tumid or depressed, very inequivalve, slightly inequilateral, rounded anteriorly, more or less truncated posteriorly; beaks prominent; surface of the valves more or less furrowed or transversely striated, covered with an epidermis. Hinge composed of a recurved primary tooth in one or both valves, with corresponding socket and ligamental pit beside it. Ligament small, interior. Muscular impressions slightly marked, united by a pallial one with a very slight sinus. The animal is short, with very short united siphonal tubes. Orifices fimbriated. Mouth closed, except in front, where there is an opening for a bony narrow thick foot of considerable dimensions. Anal siphon with a conspicuous tubular membrane. Labial tentacles slender.

This genus was once abundant in the European seas, especially during the early part of the Tertiary epoch. Only a few species now exist. It has more species in the tropical seas of the present day.

C. nucleus is one of the most common species in the seas around the British Islands. Whilst very frequently found in the dredges, it is seldom washed on shore or found in shallow waters. It is about half an inch in length and about one-fourth less in breadth.

This genus belongs to De Blainville's family *Pyloridea*, which embraces *Solen*, *Panopea*, *Mya*, and other allied species. [PYLORIDEA.]

CORCHORUS, a genus of Plants belonging to the natural order *Tiliaceæ*. The leaves of *C. olitorius* are used in Egypt as a pot-herb. Fishing-lines and nets, rice bags, and a coarse kind of linen called tat, are made in India of the fibres of *C. capsularis*.

CORDIA, a genus of Plants belonging to the natural order *Cordiaceæ*. It has a tubular calyx, 4-5-toothed. Corolla funnel shaped or campanulate, with a flat 5-7-cleft limb, and a hairy or naked throat. Stamens 5, short, inserted in the throat of the corolla. Style protruding, bifid, with 4 stigmas. Ovary 3-4-celled. Drupe containing 1 stone with 1 or 3 cells, two of which are usually abortive.

C. latifolia is a native of Hindustan. It has numerous spreading and drooping branches; the young shoots angular and smooth. The general height of trees ten or twelve years old about 20 feet. Leaves alternate, petioled, round, cordate, and ovate, often slightly repand; 3-nerved; of a hard texture, smooth above, scabrous and pale underneath; from 3 to 7 or even 8 inches long, and rather less in breadth. Petioles nearly rounded and smooth. Panicles short, terminal, and lateral, roundish; the branches alternate, diverging, and one or more frequently dichotomous. Flowers numerous, small, white. Bracts minute, villous. Calyx villous, campanulate, leathery; mouth unequally toothed. Corolla short, campanulate. Segments 5, linear-oblong; filaments as long as the segments of the corolla, and inserted immediately under their fissures. Anthers incumbent. Ovary ovate, 4-celled, with one ovule in each attached to the upper end of the axis. Style short. Stigma 4-cleft; segments long, rugose, and recurved. Drupe oblate-spheroidal, about an inch or an inch and a quarter in diameter; smooth when ripe, straw-coloured, covered with a whitish bloom. Under the name Sebesten Plums, Sebestans, or Sepistans, two sorts of Indian fruit, have been employed as pectoral medicines, for which their mucilaginous qualities, combined with some astringency, have recommended them. They are believed to have been the *Persea* of Dioscorides. Linnæus has erroneously applied the name of Sebesten to an American species of this genus which is not known in medicine.

C. Myxa is a native of many parts of India, Persia, Arabia, and Egypt. The trunk is generally crooked, from 8 to 12 feet high, and as thick or thicker than a man's body. The bark gray, cracked in various directions. Branches numerous, spreading, and bent in every possible direction, forming a dense shady head. The flowers are numerous, white, small; a very large proportion of them are sterile, and they always want the style. The drupe is globular, smooth, the size of a cherry, sitting in the enlarged calyx; when ripe, yellow; the pulp is almost transparent, very tough, and viscid. The smell of the nut when cut is heavy and disagreeable; the taste of the kernels like that of filberts. It is the true Sebesten of the European Materia Medica. The fruits, according to Roxburgh, are not used in the Circars medicinally, but when ripe are eaten by the natives, and also most greedily by several sorts of birds, being of a sweetish taste. The wood is soft, and of little use except for fuel. It is reckoned one of the best kinds for kindling fire by friction, and is thought to have furnished the wood from which the Egyptians constructed their mummy cases. The wood is said by Dr. Royle to be accounted a mild tonic.

C. Gerasacanthus is a native of the West Indies in woods, and of Mexico, near Acapulco. It has ovate oblong leaves, acute, quite entire, glabrous; racemes terminal, aggregate; flowers verticillate, sessile; calyx 10-furrowed, 10-striped, downy; limb of corolla 5-cleft; throat villous; stamens the length of the corolla. This is esteemed one of the best timber-trees in Jamaica, of which it is a native. The wood is of a dark brown colour, and gently striped; it is tough and elastic, of a fine grain, and easily worked. It is called Spanish Elm or Prince Wood by the English, and Bois de Chypre by the French.

C. Rumphii has brown wood beautifully veined with black, and smelling of musk.

There are above 100 species of this genus.

(Lindley, *Flora Medica.*)

CORDIA'CEÆ, a small natural order of Monopetalous Exogens, with a shrubby or arborescent habit, a gyrate inflorescence, and a drupaceous fruit. The leaves are alternate, usually covered with asperities, and destitute of stipules. The calyx is inferior and 5-toothed; the corolla regular, with 5 stamens proceeding from the tube, and alternate with the segments. There is a pendulous ovule in each cell, and the style is twice-forked. The cotyledons are crumpled or folded in plaits lengthwise. The affinities of the order are almost equal between *Boraginaceæ* and *Convolvulaceæ*, but preponderates in favour of the former. The only economical plants contained in it are the Sebesten Plums, the produce of *Cordia Myxa* and *Sebestena*, the rind of which is succulent and mucilaginous. All the species are tropical.

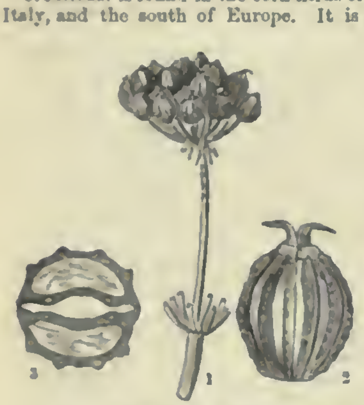
CORDIERITE. [IOLITE.]

COREGONUS. [SALMONIDÆ.]

CORIANDER. [CORIANDRUM.]

CORIANDRUM, a genus of Plants belonging to the natural order *Umbelliferæ*. It has 5 acute calyx teeth, unequal and permanent; petals obovate, emarginate, with an inflexed segment, the exterior radiating and bifid. Fruit globose, with 10 ribs scarcely separating. Half fruits, with 5 primary depressed wavy ridges, and 4 secondary ones (besides the marginals) more prominent and keeled. Channels without vittæ; commissure with 2 vittæ. Seed hollowed out in front with a loose skin. The species are smooth herbs. Leaves multifid; umbels with 3 or 5 rays. Involucre none; involucels about 3-leaved, halved.

C. sativum is found in the corn-fields of Tartary, the Levant, Greece, Italy, and the south of Europe. It is not really wild in England. The root is tapering, the stem erect, 12 or 18 inches high, more or less branched, leafy, round, striated. The lower leaves are pinnate on longish slender stalks, their leaflets wedge-shaped or fan-shaped, and acutely notched; upper leaves multifid in fine lineal segments. The flowers are white, often of a reddish tint. The fruit pale brown, somewhat coriaceous, spherical, 1½ lines in diameter; all the ridges indistinctly shown on account of their slight elevation; the vittæ of the commissure short, lunate, just visible without dissection. The fruit is carminative and aromatic. Cullen considered it more powerfully corrective of the odour and taste of senna than any other aromatic. (Lindley, 'Flora Medica.')



Coriandrum sativum.

1, a portion of an umbel, in fruit; 2, a fruit magnified; 3, a transverse section of the same.

Coriander fruit, or seeds as they are incorrectly called, are used in sweetmeats, in certain stomachic liqueurs, and in some countries in cookery: they are little esteemed in England.

CORIARIA'CEÆ, a very small natural order of Gynobasic Polypetalous Exogenous Plants, with opposite or alternate exstipulate leaves, 10 stamens, with an hypogynous insertion, and 5 distinct ovaries, with distinct spreading stigmas. The two genera, of which alone the order consists, are nearly allied to *Rutaceæ*, but their leaves are not dotted. The only plant that gives the order any interest is *Coriaria myrtifolia*, a shrub inhabiting the south of Europe, and employed by dyers for staining black. Its fruit is succulent, and said to be poisonous.

Coriaria myrtifolia.

1, a flower with its bract, the anthers not yet visible; 2, the same with the anthers projecting; 3, a cross section of the ovary; 4, a seed; 5, a vertical section of the same.

CORIOCELLA. [CHISMOBRANCHIATA.]

CORK, botanically considered, is a soft and elastic layer of bark which becomes remarkably developed in the kind of oak inhabiting Spain and Portugal. [QUERCUS; BARK.] This substance is developed in other plants, but in none in so large quantity as in the *Quercus Suber*. As soon as the bark dies it ceases to grow, and then, not distending as it is pressed upon from within, it falls off in flakes which correspond to the layers that are formed annually. These flakes are the layers of cork which the Spaniards collect under the name of the outer bark, while the inner living bark is or rather should be spared. We are told however by Captain S. Cook that the Spaniards have been in the habit of stripping off the inner bark also, although it is of no value except for tanning, and although its removal destroys the trees. The same intelligent observer states that the cork-tree occurs in Spain throughout the whole extent of the Tierra Caliente, but is most abundant in Catalonia and Valencia, whence the principal exports have been made. Cork appears to be a corruption of the Latin word 'cortex.' For the uses of Cork in the arts see CORK in ARTS AND SC. DIV.

CORK, MOUNTAIN. [ASBESTUS.]

CORK-TREE. [QUERCUS.]

CORK-WING. [CRENILABRUS.]

CORKLING. [CRENILABRUS.]

CORMORANT. [PELECANIDÆ.]

CORN-MARIGOLD. [CHRYSANTHEMUM.]

CORN-SALAD. [VALERIANELLA.]

CORNA'CEÆ, a small natural order of Polypetalous Exogenous Plants. They consist principally of shrubs, very rarely of herbaceous plants. They have opposite strongly-veined leaves without stipules; an inferior ovary, in each of whose cells is one pendulous ovule; 4 valvate petals; 4 stamens alternating with them; and a drupaceous fruit with two cells; the embryo lies in some fleshy albumen.

Cornel-Tree (*Cornus mas*).

1, an expanded flower, with the petals and stamens; 2, an ovary cut through vertically, showing a cup-like disc surrounding the base of the style, and the pendulous ovules; 3, a fruit cut so as to show the stone; 4, a vertical section of the stone, exhibiting the embryo and albumen.

Many of the species are cultivated in European gardens, especially *Cornus mas*, the Cornel-Tree; *C. alba*, *C. sanguinea*, and *C. sericea*, called Dogwood; together with *Benthamia fragifera*. They are valued either for their bright-red shoots, which in the winter are highly ornamental, or for their richly-coloured fruit. *Benthamia fragifera* in particular has its drupes collected in roundish strawberry-like heads, which have a beautiful effect in the south-west of England, where it has been several years introduced from the Himalaya Mountains. The bracts of some species of this order are very large, and resemble petals, and being white they are a gay substitute for the flowers themselves, which are small and inconspicuous. This is particularly the case with *Cornus herbacea*, *C. florida*, and *Benthamia fragifera*. Medicinally, Cornaceous plants are of great importance. The American physicians esteem the bark of *Cornus florida* and *C. sericea* equal to *Cinchona* as a febrifuge.

Formerly the *Cornus mas* used to be cultivated in gardens for the sake of its fruit, which were called Cornelian Cherries. It is a deciduous tree, with clusters of small starry yellow flowers, appearing in the spring before the leaves. The leaves are ovate-lanceolate, acute, wavy, and of a dull grayish-green. The fruit consists of oblong drupes of a red or occasionally a yellow colour; they are excessively austere before ripe, but eventually blet like medlars, and then become eatable.

This order is allied to *Umbelliferæ* and *Hamamelidaceæ*. There are 9 genera and above 40 species.

CORNBRASH, a thin calcareous member of the Oolitic Formations. It constitutes the uppermost band of the Bath Oolitic Formation, and is extremely rich in *Echinodermata* and *Conchifera*, but somewhat remarkably deficient in *Belemnites*.

CORNCRAKE. [RALLIDÆ.]

CORNEA. [EYE.]

CORNEL-TREE. [CORNUS.]

CORNELIAN, or CARNELIAN. [AGATE.]

CORNELIAN CHERRY. [CORNACEÆ.]

CORNISH CHOUGH. [CORVIDÆ.]

CORNISH DAW. [CORVIDÆ.]

CORNSTONE. The peculiar Limestone, often mottled in colour, of the Old Red-Sandstone of Hereford, Salop, and South Wales, receives this title. (Murchison, *Silurian System*.)

CORNU AMMONIS. [AMMONITES.]

CORNULITES, an obscurely characterised genus (of *Polypiaria ?*), which occurs in the Silurian Limestones and Sandstones very frequently, as at Dudley, Usk, Marloes Bay, &c. (Murchison, *Silurian System*, pl. 26, f. 5.)

CORNUS, a genus of Plants, the type of the natural order *Cornaceæ*. It has a calyx with a very small 4-toothed limb; with 4 oblong sessile petals; 6 stamens; 1 style; a baccate drupe marked with traces of a calyx; the stone 2-celled, rarely 3-celled; the seeds solitary, pendulous; the albumen fleshy; the radicle of the embryo shorter than the cotyledons. The species are trees, shrubs, or low herbs, with opposite leaves, and white flowers, sometimes yellowish.

C. sanguinea, Dog-Wood, Wild Cornel-Tree, has arborescent straight branches; ovate cuspidate leaves, green on both sides; the cymes flat, without an involucre. This plant is a shrub, reaching a height of 5 or 6 feet. Its branches are of a reddish colour. It is a native of Great Britain, in hedges and thickets. It also inhabits North America, in Canada and the State of New York; but was probably introduced there. It has a dark purple fruit, which is very bitter. Matthiolus says that it contains an oil, which is sometimes expressed, and is used for lamps. The wood is used for making charcoal, from which gunpowder is made. The fruits are sometimes mistaken for those of buckthorn, but do not possess the active properties of that plant. The wood is also used for making skewers for butchers. It is called in the country Female Cornel, Prick-Wood, Dogberry-Tree, Hound's-Tree, Gaten, and Gaten-Tree.

C. suecica, Dwarf Cornel, has herbaceous stems, the leaves all opposite, sessile, ovate; the nerves separate almost to the base; the flowers umbellate, shorter than the 4-leaved petaloid involucre. It is found in high mountain pastures in England and Scotland. It is not so large a plant as the last, and has purple flowers with yellow stamens. The berries are red and sweetish, and are supposed by the Highlanders to create an appetite, of which their name for them, 'Lus-a-Chrasis,' is expressive.

C. florida has shining branches, ovate acuminated leaves, pale beneath, beset with adpressed hairs; the flowers umbellate; the leaves of involucre large, roundish, retuse, the drupes ovate. It is a native of moist forests in the United States, especially on the borders of swamps. The bark of this tree is a powerful tonic, astringent, and antiseptic, resembling *Cinchona* in its action on the system, and much valued by American physicians. The young branches stripped of their bark, when rubbed against the teeth, render them extremely white. The bark of the roots yields a colouring-matter which dyes cloth scarlet.

C. sericea, Silky Dogwood, has spreading branches; woolly branchlets; ovate acuminate leaves, clothed with rusty pubescence beneath; the corymbs depressed, woolly; the nucleus compressed. It is a native of North America, in moist woods. It has the same properties as the last species, and is used for the cure of intermittent fevers. It is probable that these plants contain an alkaloid identical with quinine, but it has not yet been separated.

C. mas, Male Cornel, Cornelian Cherry, has smoothish branches; leaves oval, acuminate, rather pubescent on both surfaces; flowers rising before the leaves; the umbels about equal in length to the 4-leaved involucre; the fruit elliptic. It is a native throughout the continent of Europe, but is not found in Great Britain. It has yellow flowers, which are succeeded by an elliptical fruit of a bright shining scarlet colour, of the size and form of a small acorn. This plant was formerly cultivated for the sake of its fruit, but it is very inferior to many others that can be more easily produced, so that it is not now often used. The fruit is called Corbet by the Turks, and is used by them in the manufacture of sherbet. The wood is very durable.

The species of Cornus form good plants for shrubberries, and many of them will grow under the drip of trees, and in spots where other plants will not thrive. They may be propagated by cuttings, layers, or suckers.

(Don, *Dichlamydeous Plants;* Lindley, *Flora Medica;* Babington, *Manual of British Botany*.)

COROLLA, the name given by botanists to the innermost of the envelopes of which the flower is composed. Like the Calyx [CALYX] it is formed of leaves changed from the ordinary state of those parts in consequence of an alteration in the office they have to perform, but liable to resume the state of common leaves if exposed to the effect of any disturbing cause. The corolla is usually thin, delicate, perishable, and both larger and more richly coloured than the calyx; hence the older botanists considered those qualities proper to the corolla, and applied the term to all cases in which they existed. But it is now known that the calyx is frequently in the same state, and hence the only distinction that is now made between calyx and corolla is to consider everything calyx which forms the exterior of two or more rows of floral envelopes, everything corolla that belongs to the inner rows, and when there is only one row, to refer that to the calyx, whatever the colour or texture of it may be.

There is little doubt that when a calyx is green and leafy its business is principally to protect the corolla; and that a corolla when large, thin, and brightly coloured, is intended to exercise some special influence upon the fertilising organs of the flower; for while the respiratory action of the calyx when green is not distinguishable from that of common leaves, the corolla differs most essentially in the want of all power of decomposing carbonic acid; it absorbs oxygen from the air, but does not part with it again in a pure state: on the contrary, it combines it with its carbon, and throws off the carbonic acid thus formed. But although there is this difference between the calyx and corolla in ordinary cases, the functions of the corolla are performed by the calyx when it has the appearance of a corolla, and *vice versâ*. The peculiar functions of these parts are therefore performed indifferently by the one or the other according to their structure.

The leaves of which a corolla is composed are called Petals; and the endless varieties of its form and structure depend principally upon the different manner in which those parts are united, or upon the proportions they bear to each other. A Monopetalous Corolla, for instance, is composed of several petals joined more or less together by their edges; Campanulate Corollas originate from petals without a claw or unguis; Tubular Corollas from unguiculate petals. In a regular monopetalous corolla all the petals are of equal size, and are united in the same degree; in an irregular monopetalous corolla, the petals are unequal in size, and perhaps unequally united.

The corolla is generally the part of the flower in which grotesque forms are most frequently met with; such as horns or spurs projecting from the base; or a cowled figure, or dark hairy appearances resembling the bodies of insects, as in the Bee-Larkspur, various orchidaceous plants, &c. The cause of these singular forms is entirely unknown; they appear to be specific cases of which no explanation can be given. [FLOWER.]

COROLLIFLORÆ, a subdivision of the class of Exogenous or Dicotyledonous Plants. It embraces those orders in which the petals are united and the stamens are attached to those organs.

CORONARII. [AMMONITES.]

CORONILLA, a genus of Plants belonging to the natural order *Leguminosæ*. It has a campanulate calyx, short, 5-toothed, the superior teeth approximated and nearly united. Claws of the petals distinctly longer than the calyx; keel acute. Stamens diadelphous. Legume tapering, slender, finally separating into oblong 1-seeded joints. Seeds ovate or cylindrical. The species are shrubs or herbaceous plants. Leaves unequally pennated. Peduncles axillary, bearing an umbel of stalked flowers.

C. Emerus is common all over the South of Europe. It is known by the name of Scorpion Senna, and its leaves are cathartic like those of true Senna, but less so. It is a small bush. Branches deep green, strongly furrowed, quite smooth. Leaflets 2-3 pairs, obovate, retuse or obtuse, when young very downy; stipules ovate, acute, very much shorter than the first joint of the petiole. Peduncles axillary, 2-3-flowered, slender, erect, as long as the leaves. Calyx slightly downy, only half the length of the claws of the petals. Corolla deep bright yellow. Legume a long while before its joints drop in pieces.

C. varia is an herbaceous plant, with distinct lanceolate petals; the leaflets 9-13, oblong, elliptic, mucronate, the lower ones approaching the stem; the umbels 16-20-flowered; the legumes angular, very long, straight. It inhabits meadows and waste places in the south of Europe and in the Crimea. The leaves have a diuretic action on the system, and also purge. The juice is said to be poisonous when taken in large quantities; although this is the action on the human system, cattle feed on this plant with avidity, and it has been proposed to cultivate it in this country as fodder. It probably does not develop its active secretions in climates north of its native districts. In a good soil the stems grow to the height of five feet, so as amply to repay its cultivation, especially in a dry season. When once planted it is difficult to eradicate. *C. globosa* and *C. iberica* have the same tendency.

The species of *Coronilla* are numerous, and are all shrubs or herbs, adapted for ornamental cultivation. Of the hardy shrubby species, ripened cuttings root freely, and may be planted in open ground in the autumn. The frame and greenhouse species are of easy culture. They grow best in a mixture of loam and peat; cuttings strike readily in sand under a hand-glass, and may be turned out into the open border in spring, where they will flower all summer. Many of them are well adapted for rock-work, but are apt to be killed during a severe winter.

(Don, *Dichlamydeous Plants*; Loudon, *Encyclopædia of Plants*; Lindley, *Flora Medica*.)

CORONULA. [CIRRIPEDIA.]

COROPHIUM, a genus of Animals belonging to the class *Crustacea* and the family *Gammarinæ*. With the whole of the family, it is remarkable for the length of its antennæ. It has no claws. One of the species, *Cancer grossipes* of Linnæus, *Gammarus longicornis* of Fabricius, *Oniscus volutator* of Pallas, is well known on the coast of La Rochelle for its habit of burrowing in the sand. They live principally upon the annelides which inhabit the sand, and are remarkable for assembling in great numbers around their prey, and destroying it although it may be twenty times as large as themselves. They also attack fishes, *mollusca*, and the dead bodies of other animals.

CORREA, a genus of Plants belonging to the natural order *Rutaceæ*, of which one of the species, *C. alba*, is used by the settlers in Australia as a substitute for tea. (Lindley, *Vegetable Kingdom*.)

CORRIGI'OLA (diminutive of *corrigia*, a shoe-string), a genus of Plants belonging to the natural order *Paronychieæ*. It has 5 sepals slightly cohering at the base; 5 petals equalling the sepals; 5 stamens; 3 sessile stigmas; a 1-seeded indehiscent fruit; the seed suspended by its cord, which arises from the base of the capsule; the petal, as the sepal, inserted upon an obscurely perigynous ring at the bottom of the calyx. The species are procumbent glaucous herbs, with alternate stipulate leaves.

C. littoralis, Strap-Wort, has the stem leafy on the part only which bears the flowers. It is the only British species of the genus. It is found on sandy shores in England, but it is not an abundant plant. There are three or four other species described, natives of America and Africa.

(Babington, *Manual of British Botany*.)

CORSICAN MOSS. [PLOCARIA.]

CORUNDUM. Several substances differing considerably in colour, and sometimes in form, but nearly agreeing in composition, are classed together under the name of *Corundum*, which is that given to the common variety by the natives of India.

Sapphire, of which there are several varieties, the names of which are dependent chiefly upon their colour: the *White Sapphire*, which is transparent or translucent; the *Oriental Sapphire*, which is blue; *Oriental Amethyst*, which is purple; the *Oriental Topaz*, yellow; the *Oriental Emerald*, green; and some other varieties occur, as the *Chatoyant* and the *Opalescent Sapphire*. The Sapphire occurs in rolled masses and crystallised, and the primary form of this and every variety of crystallised Corundum is a slightly acute rhomboid, presenting a great variety of secondary forms; it usually occurs in the form of 6-sided prisms variously terminated. Its specific gravity is 3·975 to 4·161; it possesses double refraction, and is inferior in hardness only to the diamond. Alone before the blow-pipe it suffers no change; with borax it fuses slowly but perfectly into a colourless glass. In one direction only the crystals cleave readily parallel with the faces of the primary rhomboid, and present a very brilliant surface; the cross fracture is conchoidal. The finest are found in Ceylon. According to the analysis of Chenevix, the Sapphire consists of—

Alumina	92
Silica	5·25
Oxide of Iron	1
	——98·25

According however to Dr. Thomas Muir, this substance is pure alumina, containing no silica but what is abraded from the mortar; and this is the view adopted by modern mineralogists.

Ruby. Colour blood-red or rose-red, sometimes a tinge of violet; primary form as above, and generally occurs in 6-sided prisms. It is not so hard as the Sapphire, and is more readily cleaved. Like the Sapphire, it consists of pure alumina. "The largest oriental ruby known was brought from China to Prince Gargarin, governor of Siberia; it afterwards came into the possession of Prince Menzilkoff, and constitutes now a jewel in the Imperial Crown of Russia." (Dana.)

Common Corundum, the variety usually called *Adamantine Spar*, occurs, like the Sapphire and Ruby, commonly in the secondary form of 6-sided prisms, but usually much larger. It is sometimes nearly colourless, and rather translucent; it presents great variety of colour, but is most commonly greenish or grayish; occasionally brown or red, rarely blue. Although its most common form is the 6-sided prism, it occurs, though rarely, also in acute and obtuse double 6-sided pyramids. On account of its extreme hardness it received the name of Adamantine Spar. It occurs in China, Bengal, Malabar, Tibet, the Carnatic, &c. It is used in the East Indies for cutting and polishing precious stones, and also granite and other hard rocks that are employed in the temples and other public monuments. According to Chenevix, the Carnatic Corundum contains silica, but this does not appear to be constant.

Emery. This substance which, when reduced to powder, is much used for polishing hard bodies, though very different in appearance from the preceding, is, on account of its hardness and analysis, regarded as Amorphous Corundum. Its colour is usually gray; its lustre is somewhat glistening. Its specific gravity is about 3·66 to 4; it occurs massive, and is granular. It is principally imported from the island of Naxos in the Grecian Archipelago, and was found by Mr. Smithson Tennant to consist of—

Alumina	86
Silica	3
Oxide of Iron	4
	—93

It occurs also in Italy, Spain, and Saxony; and it is said, in small quantities, also in Wicklow, Ireland.

CO'RVIDÆ, Crows, a family of Birds belonging to the division *Conirostres*. The bill is strong, slightly cultrirostral, or more or less compressed; the gape or commissure straight. The nostrils are covered with stiff bristle-like feathers directed forwards.

"The *Nucifraga*, Briss., our British Nutcracker," says Mr. Vigors, in his paper 'On the Natural Affinities that connect the Orders and Families of Birds,' in 'Linn. Trans.,' "closely resembling the preceding groups (Fam. *Sturnidæ*) in the form of its bill, in conjunction with *Barita*, Cuv., introduces us into the family of *Corvidæ*. From that genus we may trace a line of affinities, through some intervening forms, to the Jays and Rollers, *Garrulus*, Briss., and *Coracias*, Linn., until we arrive at the *Corvus* of Linnæus, which again branches out into several groups closely allied to each other, but differing considerably in the structure of the bill. Hence we proceed by means of *Glaucopis*, Forst., to some genera, among which we may particularise *Ptilonorhynchus*, Kuhl., *Crypsirina*, Vieill., *Eulabes*, Cuv., and *Fregilus*, Cuv., which, in the metallic lustre of their plumage and the velvet-like process that in some species ornaments the face, indicate our approach to the Birds of Paradise. The last-mentioned genus, *Fregilus*, in particular, by its curved and slender bill, brings us immediately into this group, the *Paradisea*, Linn., which, in conjunction with the *Epimachus* of M. Cuvier, terminates the family of *Corvidæ*. Here we shall probably find the passage from the present to the succeeding family. The *Epimachus*, more united in its front toes than the *Corvidæ* in general, holds a middle station in respect to that character between the two groups; while in the length and curvature of its bill it approaches, in conjunction with many of the *Paradiseæ*, to some of the extreme species of the *Buceridæ*, among which the *Buceros nasutus* of Latham may be instanced." Mr. Vigors, in a note, says that he speaks with considerable hesitation as to the situation of *Epimachus*, which bears too strong a resemblance to the *Promerops* of M. Brisson, a group feeding on vegetable juices, with an extensile tongue, to permit him to separate it without some expression of doubt.

Mr. Swainson, in 'Fauna Boreali-Americana,' vol. ii., thus writes on the *Corvidæ*:—"There are some singular and highly interesting peculiarities exclusively belonging to groups pre-eminently typical, which demand the deepest attention of the philosophic naturalist. One of the most striking of these is the great difference between those forms which belong to perfect and natural genera, strictly so termed. We might cite the restricted genera, *Tanagra*, *Cashmorhynchus* (*Casmarhynchos*), and *Coccothraustes*, as remarkable examples of this fact, and as groups which would repay the most minute analysis. This peculiarity sometimes extends to higher groups; and in the present family, the most pre-eminently typical in the whole circle of ornithology, it is more striking than in any other. It is perhaps to this circumstance that we must attribute the very imperfect manner in which the internal relations of the *Corvidæ* have been illustrated, and the artificial distribution that has been made of the groups it contains. Our space indeed will not permit us at present to throw much light upon the subject, further than what may be gained by studying the following table of sub-families:—

Analogies.		Sub-families.
	1. Typical Group.	
CONIROSTRES.	Wings lengthened, obliquely pointed; lateral toes equal.	*Corvidæ*.
	2. Sub-Typical Group.	
DENTIROSTRES.	Wings shorter, rounded, convex; lateral toes unequal.	*Garrulinæ*.
	3. Aberrant Group.	
SCANSORES.	Bill short, entire, light; feet short.	*Crypsirinæ*.
TENUIROSTRES.	* * * * * * *	?
FISSIROSTRES.	Bill slender, lengthened; feet short.	*Fregilinæ*.

"A glance at the modern arrangements will show how essentially we differ from all ornithologists who like us have attempted to elucidate this very intricate family. The tests however by which every series of animals thought to be natural must be tried, will bring to light many remarkable peculiarities which belong only to the foregoing arrangement. Yet however confident we feel on the general accuracy of this sketch, we are unprepared either to show in what manner the sub-families are connected, or to refer many of the modern genera to their natural divisions. The Jays (*Garrulinæ*) unquestionably represent the Bush-Shrikes (*Thamnophilinæ*); while the genus *Crypsirinæ* and the short-legged *Glaucopinæ* of M. Temminck form part of a group typifying the Drongo-Shrikes. The slender bill of the *Fregelinæ*, at the opposite side of the circle, indicates the position of the fissirostral group, corresponding to the *Buceridæ*. But we have many doubts on the true nature of the tenuirostral type, since it must not only represent the Hang-Nest Starlings (*Icterinæ*), but also the Caterpillar-Catchers (*Ceblepyrinæ*), and the typical *Ampelidæ*, or Chatterers. Now it will strike every ornithologist who has the means of examining the *Gracula calva* of authors, that notwithstanding its general resemblance to the Chauve of Le Vaillant ('Oiseaux de l'Amérique,' pl. 49), it is decidedly a Crow; while the latter is considered by Le Vaillant as unquestionably belonging to the *Ampelidæ*. We have therefore good reason to suspect the *Gracula calva* to be one of the tenuirostral types of the *Corvidæ*. In all probability it will prove to be the sub-family type representing that tribe, although at present we choose to omit its designation in the foregoing table."

In the following article we shall describe the genera *Corvidæ*, and give examples of the species which illustrate them.

Corvus.—Bill straight, large, compressed, and a little swollen on the sides; convex and curved towards the point, its edges cutting. Nostrils open. Fourth quill the longest. Tail even, rounded, or rectilinear.

"The species *Corvus*," says M. Lesson, "is very numerous in its species. Birds which differ in their characters and habits from the crows, properly so called—which are the largest of the *Passeres*, whose way of life is carnivorous, and their food composed of all sorts of substances, especially carrion—have been joined to the genus. The crows possess much intelligence, are easily tamed, and become very familiar. They are very voracious, and live in numerous bands, and their harsh cry has been called croaking. They often commit such havoc that a price is set on their head in some countries. They have at all times been objects of superstition to the people. Some of the crows are sedentary; others again are travellers, and migrate annually. They moult but once a year."

The species of this genus are found in all the four quarters of the globe.

C. Corax, the Raven. This well-known bird is the Κόραξ of the Greeks; *Corvus* of the Latins; Corvo, Corho, and Corvo Grosso of the modern Italians; El Cuervo of the Spaniards; Corbeau of the French; Der Rabe and Der Kolkrabe of the Germans; Korp of the Swedes; Raun of the Danes; Corbie of the Scotch; Cigfran of the Welsh; Kaw-kaw-gew of the Cree Indians; and Toolloo-ak of the Esquimaux. Sir John Richardson says that it abounds in the Fur Countries, and visits the remotest islands of the Polar Seas. "It frequents the Barren Grounds even in the most intense winter colds, its movements being directed in a great measure by those of the herds of rein-deer, musk-oxen, and bison, which it follows, ready to assist in devouring such as are killed by beasts of prey or by accident. No sooner has a hunter slaughtered an animal than these birds are seen coming from various quarters to feast on the offal; and considerable numbers constantly attend the fishing stations, where they show equal boldness and rapacity. The experienced native, when he sees from afar a flock of ravens wheeling in small circles, knows that a party of his countrymen well provided with venison are encamped on the spot, or that a band of wolves are preying upon the carcass of some of the larger quadrupeds, and pushes on briskly in the certain prospect of having his wants supplied. The thievish habits of a tame raven are well known; but it is remarkable that, inhabiting in a wild state the most secluded and worst peopled districts of America, it should exhibit the same disposition to carry off shining metallic bodies and other articles totally unfit either for food or to be used in the construction of its nest. Mr. Kendall, in crossing the height of land which divides the waters that flow towards Hudson's Bay from those which fall into the Arctic Sea, saw a raven flying off with something in his claws pursued by a number of his clamourous companions. The bird being fired at dropped the object of contention, which proved to be the lock of a chest."

The aptitude of the raven for articulating clearly is generally admitted. Mr. Swainson says, "One belonging to Mr. Henslow, of St. Albans, speaks so distinctly that when first we heard it we were actually deceived in thinking it was a human voice: and there is another at Chatham which has made equal proficiency; for living in the vicinity of a guard-house it has more than once turned out the guard, who thought they were called by the sentinel on duty."

Sir John Richardson ('Fauna Boreali-Americana') states that a pied individual was killed on the south branch of the Mackenzie from a flock of the common sort. Its neck, fore part of the back, and part of the wings were gray; the rest of its plumage black.

"This," writes Dr. Latham, "is a universal species, found both in the old and new continents; from Greenland to the Cape of Good Hope in the one, and from Hudson's Bay to Mexico in the other. It was also met with by our circumnavigators in the Sandwich Isles, and at Owhyhee was held in great estimation." Its appearance is recorded in the first and second voyage of Parry as occurring within the Arctic Circle, and in Franklin's Journal. Several pairs were seen at Melville Island, and Sir John Richardson gives a description of one killed at Fort Franklin in March, 1826.

Sir James Ross ('Appendix to Sir John Ross's Second Voyage,' p. 28), speaking of the Raven, says, "This is one of the few birds that are capable of braving the severity of an arctic winter, and of enduring the scorching rays of a tropical sun without any change being produced in its plumage by the extremes of climate. Cuvier and other authors mention that in the north it is frequently found more or less white: we never saw anything corroborative of such an observation. It preserves its plumage and peculiar characteristics unchanged in every quarter of the globe."

In his 'History of British Birds,' Mr. Yarrell has gone into a minute investigation of the structure of the larynx in the Raven, in which he shows that its power of voice depends on the complicated nature of the muscular apparatus with which this organ is supplied.

C. frugilegus (Linn.), the Rook. This well-known gregarious and familiar bird (for it seems to affect the neighbourhood of man, and even not to be scared by the smoky atmosphere of great towns) is the Cornacchia Nera and Cornacchione of the Italians; Graye, Grolle, Freux, and Frayonne of the French; Corneille Moissoneuse of Brisson; Schwartze Krähe of the Germans; Roka of the Swedes; and Ydfran of the Welsh.

Head and Foot of Rook (*Corvus frugilegus*).

Belon and Caius, the latter of whom names the Rook *Spermologus, seu Frugilega*, appear to be of opinion that it is the Σπερμολόγος of Aristotle ('Hist. Anim.' viii. 3). It is doubtless, as Pennant observes, the *Corvus* of Virgil, who has happily described a flock of them—

"E pastu decedens agmine magno." ('Georg.' lib. i. v. 381.)

The Rook is spread over the greater part of Europe; but nowhere does it seem to be more abundant than in Great Britain and Ireland. Wooded and cultivated districts are its favourite haunts. The farther north the observer goes in Scotland the fewer rooks does he see. In Orkney and Shetland there are none, nor are there any in Guernsey and Jersey. They do not appear to be numerous in Denmark, nor in the southern districts of Sweden, nor in Russia and northern Asia, though they may be seen there. In Italy the Rook is common and permanent; but it appears to be migratory over a part of the continent of Europe. In France it is also common, and the following quatrain appears under the cut of it in the 'Portraits d'Oyseaux:'—

"Jamais le Freux ne hante le rivage,
Et ne se paist que de grains et de vers,
Il est oyseau commun, gros et pervers,
Qui vole en trouppe, et crie à l'avantage."

It occurs between the Black Sea and Caspian Sea; and Dr. Von Siebold and M. Bürger note it among the European birds seen by them in Japan.

Grain, and insects especially, form the food of the Rook, and there can be no doubt that it amply repays the farmer for the seed which it takes by its assiduity in clearing his land of wire-worms and the larvæ of the Cockchafer (*Melolontha vulgaris*). These last are called

Rook-Worms in many places, and the birds may be seen following the plough-tail to gather them up as the share exposes them. In the end of May and beginning of June, when the young are able to fly and go abroad with their parents, they may often be seen among the bright green leaves of the horse-chestnut and other trees, bending the branches with their weight as they assemble to pick off the cockchafers in their winged state. Where these birds have been inconsiderately destroyed on account of the supposed damage which they had done, a total failure of the crops has made the farmer glad to try to get them back again. The stick-built nest contains four or five pale greenish eggs, blotched with dark greenish-brown; these are sometimes palmed upon the undiscerning for plovers' eggs, but are easily distinguished from them. Not that a rook's egg is by any means bad, though far inferior in every respect to the other. The male is most attentive to the female whilst she is sitting, and feeds her assiduously; both are very industrious in supplying their young, and the skin under the tongue may at this season be often seen dilated into a kind of pouch by the collected food. During the building season they have great squabbles among themselves about their nests. An account of one of their battles with the herons for the possession of a disputed territory is alluded to in the article ARDEA. They frequently visit their nest-trees in the autumn on their way to roost in some distant wood, and come to them for the purpose of repairing their nest, and setting about the business of incubation early in March.

The Rook is not without the power of mimicry granted so largely to the greater part of the true crows, is docile, capable of learning amusing tricks, and becomes much attached to the kind hand that feeds it. It has been heard to imitate the note of a jackdaw (Hewitson) and the barking of dogs so perfectly that if the mimic had been out of sight no ear could have discovered the deception. (Macgillivray.)

Varieties.—White, pied, and cream-coloured. "A gentleman," says the charming author of the 'History of Selborne,' "had two milk-white rooks in one nest. A booby of a carter finding them before they were able to fly, threw them down and destroyed them, to the regret of the owner, who would have been glad to have preserved such a curiosity in the rookery. I saw the birds myself nailed against the end of a barn, and was surprised to find that their bills, legs, feet, and claws were milk-white." These perhaps were perfect albinos, and might so have continued; but instances are not wanting where the original light colour deepens into the usual sable with age. Mr. Yarrell quotes Mr. Hunt, of Norwich, who states that a gentleman of his acquaintance had in 1816 a young rook of a light ash colour most beautifully mottled all over with black, and the quill and tail-feathers elegantly barred; but when the bird moulted it became a jet-black rook, and in this state was suffered to join its sable brethren in the fields. Mr. Yarrell remarks that this agrees with his own observations, and he adds that accidental varieties will generally be found to be comparatively small and weak birds. As these young birds increase in age and gain constitutional power, the secretions, he observes, become perfect, and the plumage assumes its natural colours, whilst the assumption of white feathers by old birds is probably the effect of the converse operation of the physiological law. ('British Birds.')

It has been, and indeed still is with some, a question whether the loss of the feathers at the base of the beak in the young rook upon the first moult, is or is not a specific distinction, or merely the result of denudation from plunging the bill into the ground in search of prey. It must be borne in mind that some foreign birds resemble the rook in this particular. Mr. John Blackwall's observations ('Researches in Zoology') touching this matter are full of interest. He refers to a rook preserved in the Manchester Museum, which has its mandibles crossed near their extremities, but so slightly that the malformation could not have interfered materially with the mode of procuring food usually resorted to by rooks, as is clearly shown by the denuded state of the nostrils and anterior part of the head, both of which are entirely destitute of feathers. But he notices another specimen, in the possession of Mr. R. Wood of Manchester, which has the mandibles greatly elongated and much curved. "Now," says Mr. Blackwall, "it is evident that the bird possessing a bill thus formed could not thrust it into the ground in search of worms and larvæ of insects, as the rook is known to do habitually; and accordingly the plumage at the base of the bill of this individual, and the bristly feathers which cover its nostrils, are very conspicuous, not having sustained the slightest injury. The opinion entertained by many persons that the naked condition of the nostrils and anterior part of the head is an original peculiarity in the rook is thus satisfactorily proved to be incorrect; indeed the fact that young rooks exhibit no deficiency in these particulars is sufficiently conclusive on this point; but the possibility of an entire species being endowed with an instinct destructive of a usual portion of its organisation was probably never contemplated by these observers; it is not surprising therefore that the inference deduced from a partial view of the subject should be erroneous."

C. Corone, the Carrion-Crow, Gor Crow, Black Crow, Corby Crow, Hoody, Bran.; the Corneille Noire of the French. It has the feathers of the throat short, ovate-lanceolate, compact. Tail straight, slightly rounded. Plumage black, highly glossed, with purple reflections above and green beneath. Young similar, but less glossy.

It is found throughout England, and also in the north of Ireland and Scotland. It also inhabits Germany, France, Spain, Provence, and Italy. Temminck says it is a native of Japan.

Like the raven, the crows keep in pairs all the year, and seldom more than two are found together, unless at a feast of carrion. Its partiality to animal food has given it its various appellations, as well as that of Flesh-Crow. They are dangerous enemies where sheep are. They attack lambs and small quadrupeds, as well as the young of birds. They also eat shell-fish on the sea-shore. In default of meat they eat grain, potatoes, and have been known to feed on green-walnuts. The Carrion-Crow is an early breeder, and commences building its nest in February. The female lays four or five eggs of a pale bluish-green, spotted and speckled with two shades of ash colour and clove-brown.

C. cornix, the Hooded or Royston Crow, Gray-Backed Crow, Gray Crow, Dun Crow, Bunting Crow, Heedy Crow; Corneille Mantelée of the French. The feathers of the throat are short, lanceolate, compact; tail straight, slightly rounded; head, fore-neck, wings, and tail, black; the other parts ash-gray. Young with the plumage all dull black, except a broad band of dusky round the fore part of the body.

This bird resembles the last in its form, and in its habits is said to be even more mischievous. In the southern parts of England it is only a winter visitant, arriving from the north early in October, and departing again in April. In the western and northern parts of Scotland it remains all the year. It frequents marshes near the sea, the banks and shores of tidal rivers, as for instance the Thames. It is called Royston from its frequency in the neighbourhood of that town from October to April. Like the last species, they feed on lambs, poultry, and other animals, and when on the sea-shore partaking of *crustacea*, *mollusca*, and fish. Mr. Selby says, "I have repeatedly observed one of these birds to soar up to a considerable height in the air, with a cockle or mussel in its bill, and then drop it upon the rock in order to obtain the included fish." The Hooded Crow often pairs with the Carrion-Crow, and, what is singular, the produce are not apparent hybrids, but assume either the plumage of the Hooded Crow, or Carrion-Crow.

Pica.—Bill entire, with cutting edges, straight or curved, furnished at the base with setaceous feathers, lying forwards. Tail very long, graduated. (Vieillot.)

The *Picæ*, Magpies, feed much in the same manner as the true crows, build their nests in trees, advance on the ground by hopping, are clamorous, learn to articulate words easily, and the European species is renowned for hiding anything shining and portable that pleases its eye. This bird also has been always an object of superstition with the vulgar.

P. caudata of Ray, *Corvus Pica* of Linnæus, our common Magpie, or Pianet, is, there is hardly any doubt, the Κίττα of the Greeks. It is the *Pica* of the Romans; Gazza, Regazza, Putta, Picha, Gazzuola, Gazzara, Ghiandara, Gaggia, and Gaggia Domenicana, of the Italians; Pie, Jaguette, Dame, and Agasse, of the French; Die Elster, Die Aelster or Aglaster, of the Germans; Skade and Huus Skade of the Danes; Skior and Tnufugl of the Norwegians; Piogen of the Welsh; and Ootawa-kee-askee of the Cree Indians.

The Magpie hardly needs description, its plumage of black and white being so characteristic and well known. It is omnivorous, and lays six or seven oblong eggs of a yellowish-white, spotted with brown, and cinereous: its nest, well fortified with blackthorn twigs, is a curiosity. The female is rather less than the male, and her tail is shorter.

"This bird," says Sir John Richardson ('Fauna Boreali-Americana'), "so common in Europe, is equally plentiful in the interior prairie lands of America; but it is singular that though it abounds on the shores of Sweden and other maritime parts of the Old World, it is very rare on the Atlantic coasts of America, or near Hudson's Bay: only stray individuals passing to the eastward of the Mississippi or of Lake Winipeg. Mr. Say informs us that it winters on the Missouri, and takes its departure northwards on the 23rd of March. It does not entirely quit the banks of the Saskatchewan even in winter, but is much more frequent in summer. On comparing its eggs with those of the European bird, they are found to be longer and narrower; and though the colours are the same, the blotches are larger and more diffused. The manners of the American bird are precisely the same that we are accustomed to observe in the English one." Mr. Swainson adds, that he has been able to compare English and Arctic specimens with one from the interior of China, communicated to him by Mr. Gray, and that he cannot perceive the slightest difference whereon to build even the character of a variety, much less of a species. The tails of the Arctic specimens, he observes, are very beautiful. A white variety of this bird is occasionally seen.

The habits of the Magpie are very suspicious. Although seeking the habitations of man, it is always prompted by self-interest. "It is," says Montagu, "a great enemy to the husbandman and the preserver of game; but has cunning enough to evade their wrath. No animal food comes amiss to their carnivorous appetite; young poultry, eggs, young lambs, and even weakly sheep it will attempt to destroy by first plucking out their eyes; the young of hares, rabbits, and feathered game, share the same fate; fish, carrion, insects, and fruit, lastly grain, when nothing else can be got. It is an artful noisy bird, proclaiming aloud any apparent danger, and thereby gives notice to its associates. Neither the fox nor other wild animal can appear without being observed and haunted; even the fowler is frequently spoiled of his sport, for all other birds seem to know the alarming chatter of the magpie."

Everywhere this bird is marked for destruction, and were it not for its sagacity it would certainly long since have become extinct.

This bird is common in Scotland. Although not known in Ireland a century and half since, they are now common. This bird is very common in Norway, where the inhabitants avoid destroying it. It lives in Lapland, and is common in the Morea. It is also a native of China and Japan.

There are several foreign species of *Pica*. They occur both in the Old and New World.

Dendrocitta—a genus founded by Mr. Gould, and comprehending *Pica vagabunda* of Wagler, *P. Sinensis* of Hardwicke and Gray, and a third species, which Mr. Gould believes to have been hitherto unnoticed.

It has the bill shorter than the head, cultrated, broad at the base; culmen arched, sides subtumid; nostrils basal, partly covered with setaceous feathers. Wings moderate: fifth and sixth quills longest. Tail elongated, cuneated, the tail-feathers spatulate. Feet (tarsi) short and weak: toes moderate; hallux strong, with a strong incurvated claw.

D. leucogastra. Black; occupit, neck, transverse stripe at the base of the quills, and abdomen, white; scapulars, interscapular region (interscapulio), and lower tail-coverts, tinged with chestnut (dilutè castaneis); two internal tail-feathers ash-coloured, except at their tips.

"The shortness and comparative feebleness of the tarsi in *Dendrocitta*, and its more elongated tail, the feathers of which are equally graduated, except the two middle ones, which are much longer than the others, distinguish it from the typical *Picæ*, the common magpie, for example. These characters are in accordance with its habit of wandering from tree to tree in search of its food. It is farther distinguished by the form of its bill.

"All the species yet known are natives of Eastern Asia." (Gould, 'Zool. Proc.,' May 14th, 1833.)

D. vagabunda, Pica vagabunda, Wagler. Head, neck, and crest, of a smoke colour, or blackish gray; the back light cinnamon; the centre of the wings gray; the quills black; the tail gray, each feather being tipped largely with black; under surface pale tawny; beak and tarsi black. Length 16¼ inches; beak 1¼ inch; tarsi 1¼ inch; tail 10 inches. The species is more widely diffused than any of its congeners, being found in considerable abundance all over India. (Gould, 'Century of Birds from the Himalaya Mountains.')

Garrulus.—Bill moderate, straight, with cutting edges, inclined, and with obscure notches near the point. Tail even, sometimes rounded. (Vieillot.)

The Jays are inhabitants of the wooded districts, and live chiefly upon fruits, principally acorns and such vegetable productions. They rarely come into the open country, but make great havoc in gardens and cultivated grounds in the neighbourhood of woodlands. Their food is much less varied than that of the true crows; but they may still be styled omnivorous. Their plumage is generally gay, and even brilliant: the beautiful speculum on the wing is a leading character. The manners of the foreign species are analogous to those of the foreign magpies. Those of the Common Jay and its aptness at imitation are well known.

G. glandarius, the Common Jay, is supposed by Belon to be the Μαλακοκρανεὺς of Aristotle; and we may observe, in confirmation of this opinion, that the editor of the last edition of Pennant says, that the bird is very common in Greece, where it still retains its ancient name, Μαλακοκρανεὺς. Belon states it to be the Gaza Ghiaudaia, or Ghiandara, the Gaza Verla, and the Berla, of the Italians; and the Prince of Canino gives *Ghiandaja, Pica, Pica ghiandaja*, and *Pica palombina* as its Italian appellations. It is the Jay and Geai of the French, the Eichen-Häher (Oak-Jay), Holtzschryer (Wood-Cryer), or Holz-Häher, of the Germans; and Screch y Coed of the Welsh.

The Jay, like the Magpie, is too well known to require description. Its beautiful colours make it one of the handsomest of our native birds. It builds its basket-like nest in trees or high coppice-wood and hedges, and lays five or six eggs of a dull whitish olive, mottled very obscurely with pale brown; towards the large end there are usually two or three black lines. It is a sad enemy to gardeners. Fruits, especially cherries, and peas are its great favourites, and it is frequently taken by springes set upon the rows of peas when in bearing. Dr. Kramer says that it will kill small birds. With regard to their imitative powers, Bewick says, "We have heard one imitate the sound made by the action of a saw so exactly, that though it was on a Sunday, we could hardly be persuaded that the person who kept it had not a carpenter at work in the house. Another, at the approach of cattle, had learned to hound a cur dog upon them, by whistling and calling upon him by his name. At last, during a severe frost, the dog was, by that means, excited to attack a cow big with calf, when the poor animal fell on the ice, and was much hurt; the jay was complained of as a nuisance, and its owner was obliged to destroy it."

Dr. Latham says he has seen two varieties; the one pure white, the other as in the Common Jay, but having the whole of the quills white.

The author last quoted states that this species, though not nearly so far spread as the magpie, exists in various parts of the continent of Europe, and that he has observed it among drawings done in China.

There are several foreign species, both of the New and Old World. Mr. Gould, who figures three species in his 'Century of Birds,' well observes that, "The close affinity which the *Garrulus lanceolatus* bears to some species inhabiting the United States and Mexico is worthy of remark, as a corroboration of the fact so often insisted on, that similar forms of ornithology are found in countries widely separated from each other, whose temperatures are alike." Indeed, the last-mentioned bird immediately reminds the observer of the Blue Jay (*Garrulus cristatus*) of America, while *Garrulus bispecularis* recalls the common jay to his recollection.

Picathartes—a genus founded by M. Lesson, who takes for the type the Pie Chauve (*Corvus gymnocephalus* of Temminck).

It has the bill convex, not very robust, the upper mandible higher than the lower; the latter a little swollen towards its extremity; the base entirely without hairs, and furnished with a cere. Nostrils placed on the middle of the bill, oval, open, hollowed into an oblong excavation. Head entirely naked. Feet (tarsi) long, but little scutellated in front, naked behind; claws feeble; wings rounded, short. Tail long, graduated. (Lesson.)

"The form of this singular bird," says M. Temminck, "the cut of its wings, and its long conical and very graduated tail, serve me as indicia to judge by analogy of what country it may be a native, its locality being unknown. In fact, on comparing our new species with the Piapic of Le Vaillant (*Corvus Senegalensis*), one is inclined, from the marked analogy, to conclude Africa to be its country. Some data, which it is nevertheless not prudent to trust, lead me to believe that the only individual known, which is in the collection of Mr. Leadbeater of London, was brought from the English possessions on the coast of Guinea."

"Proportions (taille) a little stronger, tarsi much longer, and a tail less in proportion distinguish our bird from the Piapic. The head in certain points offers some resemblance to that of the *Gracula calva* of the Philippines, and this approximation is so strong that it would produce doubts as to its African origin, if it did not bear a greater resemblance in its general contour to the Piapic of Africa. In fine, if this bird is not African, it can only be a native of the Philippino Islands."

Picathartes gymnocephalus.

Upon this passage M. Lesson remarks, that he does not find the least analogy between the figure of the Enlum., 538, which is the *Corvus Senegalensis*, and the Pie Chauve, which more resembles a

Cathartes. The conclusion stated in M. Temminck's last sentence M. Lesson is far from admitting.

The following is Temminck's description of the species: "The naked parts of the head offer a particular character. The whole of the auditory meatus is completely destitute of feathers and even of hairs. A small border, or rudiment of membrane, forms, below the orifice of the ear, a sort of external concha, but little apparent, it is true, in the stuffed specimen, but the extent of which must be remarkable in the living bird. All this part of the organ of hearing, as well as a part of each side of the occiput, are covered by a black skin with a slightly-projecting orbicular border, and forming a rounded plaque. The cere which envelops the base of the bill is also black. All the rest of the naked parts of the head, the mesial line of the occiput which separates the black plaques of the temples, and the upper part of the top of the neck, appear to me to have been red or rosy in the living subject; a slight tint of rosy-yellow covers these parts in that before us. The whole of the nape is covered, clearly, by a whitish and very short down. The front of the neck and all the other parts are white. The back, well covered with thick-set feathers, is of an ashy-black; all the rest of the plumage is bistre brown. The feet are yellow, and the bill is black. Length 15 inches." (Temm.)

Podoces.—This genus was founded by M. Fischer, for a bird discovered by Dr. Pander, in the country of the Kirgise beyond Oremburg, whose habits of life are analogous to those of the crows, among which M. Lesson thinks it ought to be placed.

The bill is moderate, of the length of the head, bending downwards at its point, without a notch, and slightly angular, the upper mandible shorter than the lower, receiving and covering the edges of it. Nostrils basal, rounded, large, covered with setaceous overhanging feathers (plumes setacées retombantes). Feet robust and long; claws triangular, very much pointed, and but little curved; a warty membrane bordering the thickness of the phalanges. First quill short, second long, the three next equal. Tail rectilinear. (Fischer.)

P. Panderi. Greenish glaucous above; eyebrows white; bill and claws blackish; feet greenish. The bird flies badly but walks very well. It lives in flocks.

Podoces Panderi.

Myophonus.—Bill very large, strong and hard, furnished at its opening with some stiff bristles and small feathers turned forwards. Nasal fossæ sub-oval, closed by a large membrane. Wings rounded, moderate. Quills nearly equal, the third longest. Feet very long, demiscutellated. Tail rounded.

There are several species, all oriental. Mr. Gould, who has published two, namely, *M. Horsfieldii* and *M. Temminckii*, in his 'Century,' states that, as regards the habits of these birds, little can be said with certainty, but that from their lengthened tarsi and general structure they may be considered as depending in a great measure for their subsistence upon worms, insects, and larvæ. The manners of *M. Temminckii*, when on the ground, are said much to resemble those of the English blackbird. It may be questionable whether this group is properly placed among the *Corvidæ*.

M. flavirostris (*M. metallicus*, Temm.) Entirely of a deep blue-black with metallic tints. Bill of a beautiful yellow. Feet black. It inhabits Java.

Myophonus flavirostris.

Ptilonorhynchus.—Bill strong, robust, widened, rather long, upper basal termination convex, but little marked; point recurved; upper mandible presenting two small notches at its extremity; edges a little swollen; lower mandible slightly convex; commissure of the mouth straight, simple. Nostrils basal, lateral, furnished with short bristles. Wings short, rounded. Tail moderate, graduated. Feet slender. (Lesson.)

The genus, as modified by Lesson, contains but two species. He thinks that it would be better placed among the *Dentirostres* at the side of the Choucaris (*Graucalus*, Cuvier); but he allows that it has all the forms of the Rollers (*Coracias*) and of the Crows. Locality, the warmest islands of the West Indian Archipelago.

P. Sinensis, Coracias Sinensis, Latham. Body above pale aquamarine green clouded with yellowish-green. Forehead furnished with silky round feathers turned in different directions; feathers of the nape long, unravelled as it were, capable of being erected into a tuft—both of a yellowish-green. A black band taking its rise from the angle of the bill surrounds the eye and nape. Throat and cheeks of a yellowish-green. Lesser wing-coverts brown. Quills brown, inclining to olive externally and chestnut internally; the last three progressively terminated with greenish white. Bill red, surrounded by a few black bristles; feet reddish. Size 11 inches. Locality, the Philippine Islands.

The other species, according to Lesson, is *Kitta thalassina*, Temminck.

Kitta.—Bill short, convex, compressed on the sides; upper mandible with the basal termination recurved, and depressed sides; the point sharp and furnished on each side with a small projecting tooth, borders of the mandibles thick, recurved, and covered at the commissure. Nostrils basal, transversal, hidden by the silky feathers of the forehead, and by a row of small bristles. Wings pointed. Tail equal, rounded. Feet robust; toes equal; hallux strong. (Lesson.)

Lesson, who places in this genus *Kitta holosericea*, *Ptilonorhynchus Smithii*, and *Kitta virescens*, says that what was observed as to the last-mentioned genus is applicable to this, which has the general characters of the Rollers and Rolles (*Colaris*).

The birds composing the genus are exclusively peculiar to Australia and the temperate zone. (Lesson.)

K. holosericea, Temminck; *Ptilonorhynchus holosericeus*, Kuhl; Satin Grakle, Latham; *Ptilonorhynchus Mac-Leayii*, Latham MSS., Vigors and Horsfield.

Ptilonorhynchus Sinensis.

Male, very brilliant blackish-blue. Quills and tail-feathers dead black. Bill and feet yellow. A double row of silky and velvety bluish-black feathers at the base of the bill. Length 13 inches. The female has the upper parts of an olive-green. The quills and tail-

Satin-Bird (*Kitta holosericea*).

feathers of a red-brown; wing-coverts varied with brown and a colour inclining to olive; lower parts greenish, barred with black. There are whitish horizontal spots, lanceolated, and bordered with black, on the front of the neck.

Mr. Caley says (Vigors and Horsfield, 'Linn. Trans.,' vol. xv. p. 264) that "the male of this species is reckoned a very scarce bird, and is highly valued. The natives call it Cowry, the colonists Satin-Bird. I have now and then met with a solitary bird of this species; but I once saw large flocks of them on some newly-sown wheat, from whence they fled on being scared into a neighbouring brush. When all was again quiet they soon returned to the wheat. They did not leave the brush above a few yards. There were no black ones among them, nor can I affirm that they were feeding on the wheat."

Nucifraga.—Bill long, thick, with cutting edges terminating in a blunt point, furnished with setaceous feathers at the base, the upper mandible longer than the lower. Nostrils round, open. Wings pointed; fourth quill longest.

Till the publication of Mr. Gould's *Nucifraga hemispila* (see 'Century of Birds') but one species was known, namely, that which we select as the example:—

N. Caryocatactes, Brisson, the Nutcracker; *Caryocatactes nucifraga*, Nils.; *Corvus Caryocatactes*, Linnæus, the Casse-Noix of the French; the Tannen-Häher of the Germans; the Noddekrige of the Danes; the Not-Kraake of the Norwegians; and the Aderyn y Cnau of the Welsh.

This bird is somewhat less than the Jackdaw. The bill is straight, strong, and black. Head, neck, breast, and body, rusty brown. Crown of the head and rump plain, the other parts marked with triangular white spots. Wings black. Coverts spotted like the body. Tail rounded at the end, black, tipped with white. Legs dusky. Locality, most parts of Europe; but the Prince of Canino does not notice it in his 'Specchio Comparativo.'

Pyrrhocorax.—Bill moderate, compressed, subulate, rather slender, furnished at the base with feathers directed forwards, and at the extremity of the upper mandible with two small teeth which are often wanting. Nostrils basal, ovoid, open, hidden by bristles. Feet robust; claws strong and recurved. Fourth and fifth quills longest.

These birds, the Choquards of the French, live in troops like the Jackdaws, which they resemble in their manners. They inhabit the high mountains of Europe, and especially the snowy regions of the Alps. They are omnivorous, feeding on insects, worms, soft fruits, and seeds. They moult once a year, and the sexes are alike externally.

P. Pyrrhocorax. Brilliant black, but the colour is dull in youth, and the bill and feet are black. In the adult bird the black presents iridescent and changeable tints varying to greenish; the bill is yellowish, and the feet bright red. The female lays four white eggs, spotted with dirty yellow; the nest is in holes of the rocks. Locality, Alps of Switzerland. The Prince of Canino ('Specchio Comparativo') notes it as rare, and only occurring in the Apennines.

Fregilus.—Bill longer than the head, slender, entire, arched, pointed. Nostrils covered with feathers directed forwards.

Lesson is of opinion that this genus ought to be united with the last, from which it only differs in having the bill longer and more curved, which made Cuvier place it in the tribe of *Tenuirostres*, near the Hoopoes (*Upupa*). The species have the manners, habits, and general organisation of the crows; and the European species (selected here as an example) perfectly resembles *Pyrrhocorax*. (Lesson.)

F. graculus, Temm.; *Corvus graculus*, Linn. The Cornish Chough, or Red-Legged Crow, is considered by Belon, on no bad grounds, to be the Κορακίας, the Κυρώνη φοινικόρυγκος (Red-Billed Crow) of the Greeks and the *Pyrrhocorax* of the Romans; Spelvier, Taccola, Pason, Zorl, of the Italians (Belon); Choucas aux Pieds et Bec Rouge, Choquar, Choüette Rouge, of the French (Belon); Stein-Tahen and Stein-Frae of the Germans; and Brân Big Gôch of the Welsh.

Back beautifully glossed with blue and purple. Legs and bill bright orange, inclining to red. Tongue almost as long as the bill, and a little cloven. Claws large, hooked, and black. The Chough builds its nests in high cliffs or ruined towers, and lays four or five eggs, white, spotted with dirty yellow or light brown and ash colour.

It is a native of England in Devonshire, Cornwall, and Wales. Pennant says that it is found in different parts of Scotland as far as Straithnavern, and in some of the Hebrides. He also states that it is found in small numbers on Dover cliff, where they came by accident; a gentleman in that neighbourhood had a pair sent as a present from Cornwall which escaped and stocked these rocks. They sometimes desert the place for a week or ten days at a time, and repeat it several times in the year. Montagu, speaking of this locality, says, "We believe the breed in those parts is again lost." Latham states that it is also said to frequent the South Downs about Beachy Head and Eastbourn, where it is called the Red-Billed Jackdaw. With regard to its general geographical distribution, Pennant observes that we do not find it in other parts of Europe except England and the Alps. In Asia the island of Candia produces it; in Africa, Egypt, which last place it visits towards the end of the inundations of the Nile. He quotes Pliny, Brisson, Belon, and Hasselquist, for these statements. The editor of the last edition of Pennant says that the Chough inhabits the lofty cliffs about the mid region of the highest mountains of Greece, but never the maritime parts, as with us. Scopoli speaks of it in Carniola, and says that the feet of some during autumn turn black. These were probably young birds.

The Cornish Chough is easily tamed, and may be taught to speak. One in Colonel Montagu's possession would stand quietly for hours to be soothed and caressed, but would resent an affront both with bill and claws. "It is," says Pennant, "active, restless, and thieving; much taken with glitter, and so meddling as not to be trusted where things of consequence lie. It is very apt to catch up bits of lighted sticks, so that there are instances of houses being set on fire by its means, which is the reason that Camden calls it 'Incendiaria avis.'" Several of the Welsh and Cornish families bear this bird in their coat-of-arms.

There are foreign species—*Fregilus leucopterus*, Vigors and Horsfield (*Pyrrhocorax leucopterus*, Temminck), from Australia, where it is called by the natives Waybung, according to Mr. Caley, and *Fregilus Enca*, of Horsfield, from Java, for instance.

Paradisea.—[BIRDS OF PARADISE.]

Astrapia.—Bill smooth at the base, compressed laterally, straight above, pointed, notched, and bent towards the extremity. Tail very long and very graduated.

Pie de Paradis.

This genus was founded by Vieillot for a bird of the most brilliant plumage, which with other characters places it near the Birds of Paradise, while it has several points which would lead to arranging it among the Thrushes. Thus Gmelin gave it the name of *Paradisea nigra*, and Latham that of *Paradisea gularis*, while Cuvler considered it to come under the genus *Turdus* (Merle de la Nouvelle Guinée). This beautiful bird is the Pie de Paradis or Incomparable of the French. Lesson says:—"I brought from New Guinea two individuals of this magnificent bird, the value of which is sufficiently considerable in France, and which seems to be very rare even in its native country; for, during our sojourn at the Moluccas and the land of the Papous, I only saw there two birds, and one of these now embellishes the galleries of the museum where I deposited it."

No description can convey any idea of the brilliancy of this bird. The metallic tints of almost every hue, varying with the play of the light on the plumage, almost surpass belief. It is well figured in Le Vaillant's 'Oiseaux de Paradis,' plate 20 and 21; but no colouring can give the slightest notion of its splendid intensity and variety. The form may be imagined from the preceding cut taken from the plates above mentioned.

Fossil Corvidæ.

Dr. Buckland mentions the remains of the Raven as occurring in the cave at Kirkdale, and figures the right ulna of one of those birds in 'Reliquiæ Diluvianæ,' plate xi.

CORVUS. [CORVIDÆ.]

CORYDA'LIS, a genus of Plants belonging to the natural order *Fumariaceæ*. It has a calyx composed of two sepals, or absent; 4 petals, the upper one spurred at the base; the stamens diadelphous; the pod 2-valved, many seeded, compressed. The species are mostly small glaucous herbs, with ternate or pinnated leaves, and fusiform tuberous or fibrous roots. Upwards of 40 species of this genus have been described. They are natives of the temperate parts of the earth in the four quarters of the globe.

C. claviculata, White Climbing Fumitory, has a fibrous root; pinnate leaves, with acuminate bracts, the pinnæ ternate; footstalk ending in tendrils. It has small pale-yellow or nearly white flowers. It has a slender climbing stem, 1 to 4 feet long. It is found in bushy places in hilly districts of Great Britain and throughout Europe.

C. lutea, Yellow Fumitory, has a fibrous root, triternate leaves; minute oblong cuspidate bracts; shining seeds, granulate-rugose, with a patent denticulated crest. This plant is a native of the south of Europe, in the fissures of rocks and old walls. It is now naturalised in Great Britain, and forms a picturesque object on the old walls of ruins, as at Castleton in Derbyshire, and Fountains Abbey, Yorkshire. It is a very common plant in gardens.

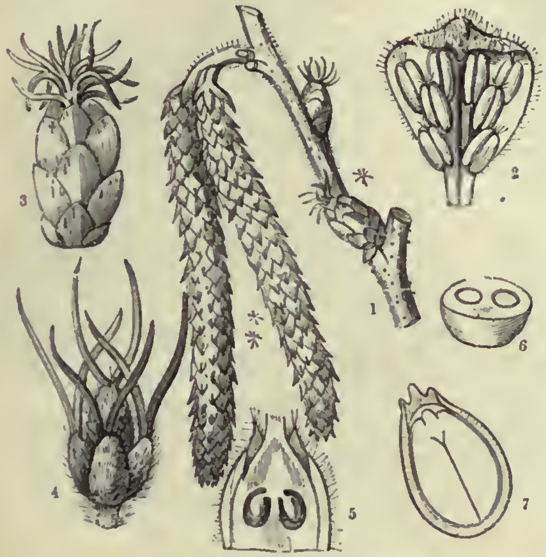
C. solida has a tuberous solid root, with biternate cut leaves, the lowest petiole a leafless scale, the bracts palmate. It is found in Great Britain, but has been undoubtedly introduced.

C. Fabacea has a nearly simple erect stem, scaly under the lower leaf; the leaves stalked, biternate; the bracts ovate, acute, longer than the pedicles. It is a native of shady mountainous places in Sweden, Denmark, and many other parts of the continent of Europe. This species, as well as *C. tuberosa*, a native of the South of Europe, has a tuberous root. The root of both the species is very bitter and rather acrid. That of *C. tuberosa* is hollow, and is found to contain a peculiar alkali called Corydalin. On the continent these roots are used under the name of *Radix Aristolochiæ*, and are employed as external applications to indolent tumours. *C. bulbosa* has a tuber which is somewhat aromatic, extremely bitter, slightly astringent, and acrid, and was formerly used as a substitute for Birth-Worts in expelling intestinal worms, and as an emmenagogue.

Many of the species are cultivated in Great Britain, and, having escaped from gardens, are occasionally found wild, but only *C. claviculata* is a native; *C. lutea* is naturalised. In cultivation they require a light rich soil. They are well adapted for flower-borders and rock-work. The perennial species may be propagated by dividing the roots, the annual by seeds, which should be sown where they are intended to remain. They will grow well under trees if the soil be not very dry.

(Don, *Dichlamydeous Plants*; Lindley, *Flora Medica*; Loudon, *Encyclopædia of Plants*; Babington, *Manual of British Botany*.)

CORYLA'CEÆ, *Mastworts*, the Oak-Tribe, a highly important natural order of Apetalous or Incomplete Exogenous Plants, consisting of trees or shrubs, chiefly natives of the colder parts of the world, and valuable either for the nuts they bear or the timber they produce. The Oak, the Beech, the Hazel, the Hornbeam, and the Sweet Chestnut, all belong to this order, the general character of which is briefly this:—Leaves alternate, usually serrated, often with veins running straight from the midrib to the margin, beyond which they slightly project; at the base of each leaf a pair of membranous stipules. Flowers monœcious; the males in catkins; the females in bud-like clusters. Stamens from 5 to 20, arising from the scales of the catkin. Ovary inferior, crowned by a toothed obsolete calyx, seated in a membranous cup or involucre, with more cells than one, and as many styles as cells; ovules solitary or in pairs, pendulous; all the ovules except one and all the cells disappear after the flowering is over, and when the fruit is ripe there is but one cell and one seed, whatever their number may originally have been. Fruit, a nut (called also acorn, mast, &c.), inclosed within a peculiar kind of involucre or cupule composed of bracts more or less united together, and forming a cup in the oak, a husk in the filbert, and a spiny case in the chestnut and beech. The seed consists of a roundish embryo, with thick fleshy cotyledons, and no albumen. The most southern of the species of this order is the Beech, of which many varieties occur in the lower parts of South America, Australia, and New Zealand. The order is allied to *Juglandaceæ*. For particulars respecting the genera of this most important family of plants see CARPINUS; OSTRYA; CORYLUS; FAGUS; CASTANEA; QUERCUS; LITHOCARPUS.



Flowers of the Hazel-Nut (*Corylus Avellana*).

1, a branch, with the male flowers ** in drooping catkins; the females * in bud-like clusters; 2, one of the scales of the male catkin, with the stamens attached to it; 3, a female bud, with the styles projecting beyond the bracts; 4, the young ovaries with the bracts removed; 5, a section of the ovary, exhibiting the ovules, the toothed calyx, and the base of the style; 6, a cross section of the ovary; 7, a longitudinal section of a nut.

CORYLUS, a genus of Plants after which the natural order *Corylaceæ* receives its name. It consists of the different species of hazel-nut, and is distinguished from the genera associated with it by its cupule being a two-leaved lacerated husk, and its ovary having but two cells, in each of which is one ovule.

C. Avellana, the Common Hazel-Nut. This plant, which is a native of all the cooler parts of Europe, Northern Asia, and North America, is the parent of the many varieties of nuts and filberts now cultivated for their fruit. [HAZEL-NUT, FILBERT, in ARTS AND SC. DIV.] It is specifically known by its husks being hispid with glands, leafy, broad, much lacerated, and rather spreading at the point; never contracted into a long tube, nor divided into narrow rigid segments; by its rounded, heart-shaped, very rugose, angular, toothed, cuspidate leaves, glandular-hispid branches, and shrubby habit. It varies very much in the form of its husks, in the degree of their hispidity, some being nearly smooth, in the shape of their nuts, and in the height to which it grows. In the Hazel-Nut the husk is open at the point, shorter or at least but little longer than the nut, and nearly smooth; while in the Filbert (*Corylus tubulosa* of some writers) it is lengthened considerably beyond the nut, and covered more or less with glandular hairs; all degrees of intermediate structure may be found in the cultivated varieties. This plant is found as a large shrub having numerous stems rising from the root, or as a small bushy tree with a great number of branches, which are covered with hairs when it is young. It is found all over Great Britain, from Cornwall to Sutherlandshire. It grows at the height of 1600 feet above the level of the sea, in the north of England and Scotland. It is cultivated very generally on account of its nuts, especially in the county of Kent, where it attains its greatest perfection. It is also cultivated on the continent of Europe; and every year large quantities of the nuts are brought into England from various parts of France, Portugal, and Spain. The hazel is valued in planting principally as an undergrowth. Its branches and stems are used for various kinds of wicker-work. The wood is said to make the best charcoal for gunpowder, and is also used for making crayons for drawing purposes.

C. Americana is not distinguishable as a variety from the last species. The Beaked American or Cuckold-Hazel is a pretty purple-leaved kind in shrubberies.

C. rostrata, the Horned Hazel-Nut. In this the branches are quite free from glandular hispidity, the leaves are oblong, not cordate, doubly toothed, and acuminate, and the husks globular over the nuts, where they are extremely hispid, without ever being glandular; beyond the nuts the husks are contracted into a tube an inch or more long, and irregularly lacerated at the point. It is a very distinct species inhabiting the mountains of the Carolinas, where it rarely exceeds three or four feet in height. In gardens it is scarcely larger.

C. Colurna, the Constantinople Nut, a white-barked tree 20 feet and more high, with an erect trunk and a dense spreading head. The leaves are shining, much less rugose than in the hazel-nut, cordate, angular, serrated, acute or acuminate, slightly hairy on the under surface. The branches and all the other parts are destitute of glands; the husks are campanulate, deeply cut into narrow hairy rather falcate segments. The nuts are roundish and very hard. It is a native of Asia Minor, and known from all the other garden species by its becoming a tree. It seldom produces its nuts in this climate.

Besides these there are the *C. lacera* and *C. ferox*, two species found in the Himalaya Mountains. Of these, the former, gathered in Kumaon, is hardly different from *C. Colurna*; the other, from Mount Sheopore, has narrow taper-pointed leaves, and excessively hard nuts inclosed in a husk, with divaricating narrow spiny divisions.

CORYMB, a form of inflorescence approaching very nearly to the raceme. The raceme consists of an axis, upon which all the flowers are disposed upon footstalks of the same length; and hence its figure is more or less cylindrical. A corymb consists of an axis, the lowermost flowers on which have very long stalks, and the uppermost very short ones, so that the mass of inflorescence is an inverted cone, as in candytuft and many other cruciferous plants. The corymb is, in fact, an umbel with a lengthened axis.

From this word is derived the term Corymbose, which is applied not only to flowers, but to any kind of branching in which the lowermost parts are very long and the uppermost very short, as is the case in most species of *Aster*. [INFLORESCENCE.]

CORYMBIFERÆ, one of the primary subdivisions in the system of Jussieu, of the natural order *Compositæ*. It comprehends most of the *Tubuliflorœ* of De Candolle. It is characterised by the absence of albumen, an erect seed, a hemispherical involucre, and the florets of the ray, if present, ligulate. This division comprises by far the largest number of the genera of the large order *Compositæ*. The species of *Corymbiferæ* produce more active secretions, and have been used more extensively by man than those of the other subdivisions of the order. They generally represent the *Cichoraceæ* [CICHORACEÆ] in hot climates, and this will perhaps account for their more active properties. In Great Britain the *Corymbiferæ* are more numerous than either the *Cynaraceæ* or *Cichoraceæ*. The number of species in the second edition of Babington's 'Manual of British Botany' is—

Corymbiferæ	62
Cichoraceæ	51
Cynaraceæ	26
Compositæ	139

De Candolle estimates that the species of the *Compositæ* form a tenth part of the flowering plants in the world, and this is about the proportion in which they occur in Great Britain.

The following is a synopsis of the British genera of *Corymbiferæ*:—

Tribe I. EUPATORIACEÆ.
Section I. *Eupatoreæ*.
Eupatorium cannabinum
Section II. *Tussilagineæ*.
Petasites vulgaris
Tussilago Farfara

Tribe II. ASTEROIDEÆ.
Section I. *Astereæ*.
Aster Tripolium
Erigeron . . . 3 species
Bellis perennis
Solidago Virgaurea
Chrysocoma Linosyris
Section II. *Inuleæ*.
Inula . . . . 3 species
Pulicaria . . 2 species

Tribe III. SENECIONIDEÆ.
Section I. *Heliantheæ*.
Bidens . . . 2 species
Section II. *Anthemideæ*.
Anthemis. . . 5 species
Achillea . . . 4 species
Diotis maritima
Chrysanthemum 2 species
Pyrethrum . . 3 species
Matricaria Chamomilla
Artemisia . . 5 species
Tanacetum vulgare
Section III. *Gnaphalieæ*.
Filago . . . 3 species
Gnaphalium . 5 species
Antennaria . . 2 species
Section IV. *Senecioneæ*.
Doronicum . . 2 species
Cineraria . . 2 species
Senecio . . . 9 species

The properties of this division of *Compositæ* are characteristic. Bitterness, with an aromatic odour, is common to all the species. Whether the bitterness depends on an alkaloid or not, chemists have not determined. Many of the species possess properties very similar to those possessed by quinine, and are administered in the same diseases as cinchona; among these are species of the genera *Inula*, *Piqueria*, *Mikania*, and *Emilia*. This bitter principle seldom however gives the character to the plant alone, but is combined with some aromatic oil, which gives the plant the properties of both a tonic and a stimulant. Such a combination is found in many of the species of the genera *Anthemis*, *Artemisia*, *Diotis*, *Santolina*, *Chrysanthemum*, *Eupatorium*, *Liatis*, &c. Sometimes the volatile oil is more prominent than the bitter principle; and this is obvious in the species of *Pyrethrum*, *Tanacetum*, *Stenactis*, *Erigeron*, &c. In some of these the volatile oil assumes the characters of turpentine and the oil of juniper, and acts as a diuretic; hence a certain number of these plants have the reputation of stimulating the action of the kidneys. In some the volatile oil assumes an acrid character, as in *Bidens*, and acts as a sialogogue, as in *Pyrethrum* and *Spilanthes*; in *Maruta* it is sufficiently active to produce vomiting. In some a secretion is produced, similar to that which gives the character to *Cichoraceæ*. Thus *Buphthalmum salicifolium* is said to possess narcotic powers, and the *Arnica montana* is stated by Burnett to have yielded a principle identical with Cytisine, the active principle of the laburnum. Some of the species yield a fixed oil. In addition to the acrid oil in *Pyrethrum officinale*, there is a butyraceous matter, consisting principally of stearine. The seeds of the species of *Helianthus* yield a fixed oil on expression, and this is probably not confined to the seeds of this genus. These seeds also contain nutritive matter (protein?), and are the support of birds and sometimes of man, in America. Another group yield colouring-matters: *Anthemis tinctoria*, and the species of *Calendula* and *Bidens*, are used for dyeing yellow; the *Tanacetum vulgare* for dyeing green. The roots of many species contain starch, and in quantities large enough to afford food for man, as in the tubers of *Helianthus tuberosus*. Many of the species also yield the peculiar kind of starch known by the name of Inulin, so named after the Inulas in which it was first found. Some of them appropriate potash in the spots where they grow, and a species of *Erigeron* is remarkable for the large quantities of this alkali which it contains. Gum is a secretion found in considerable quantities in some species, as of *Gnaphalium*, *Conyza*, and *Tussilago*, and on this account they have been used in medicine as demulcents. Tannin is not found in any quantity in this tribe of plants, so that they seldom exert an astringent action upon the system; the *Achillea millefolium* seems however to possess this property. Many of the ornaments of the garden belong to the *Corymbiferæ*. The *Dahlia*, *Chrysanthemum*, *Xeranthenum*, *Aster*, *Erigeron*, *Solidago*, *Coreopsis*, and *Tagetes*, are amongst the genera that afford the most showy and highly valued flowers in the autumn of the year. Although the properties and uses of these plants in relation to man are important, yet in proportion to the position they occupy in the vegetable kingdom, they are few. Many orders which yield a much smaller number of species afford much more abundant materials for the use of man.

(Lindley, *Flora Medica*; Lindley, *Vegetable Kingdom*; Babington, *Manual of British Botany*; Burnett, *Outlines of Botany*.)

CORYNE. [POLYPIFERA.]

CORYNEPHORUS, a genus of British Grasses, belonging to the tribe *Avenineæ*, with the following characters:—Awn club-shaped, straight, jointed in the middle, the upper portion clavate, a tuft of hairs at the joint, panicle lax, glumes 2-flowered. There is but one species, *C. canescens*, which has a rather dense elongated panicle, the glumes acuminate, longer than the flower, the awn coming from near the base of the palea, the leaves setaceous. It is a native of the sandy coasts of Norfolk and Suffolk and Jersey. (Babington, *Manual*.)

CORYPHA, a genus of Plants belonging to the natural order *Palmaceæ*. It has gigantic fan-shaped leaves, flowers with a 3-toothed calyx, 3 petals, 6 stamens, and a 3-celled ovary. The fruit is composed of round 1-seeded berries.

C. Talliera, the Tara, or Talliera, is an elegant stately species inhabiting Bengal. Its trunk is about 30 feet high, and as nearly as possible of equal thickness throughout. The leaves are in about 80 divisions, each 6 feet long by 4 inches broad, radiating from the point of a leaf-stalk from 5 to 10 feet long, and covered with strong spines at its edge. Roxburgh describes the spadix as decompound, issuing in the month of February from the apex of the tree and centre of the leaves, forming an immense diffuse ovate panicle of about 20 or more feet in height. The fruit is the size of a crab-apple, wrinkled, dark-olive, or greenish-yellow. The leaves are used by the natives of India to write upon with their steel styles, and for other purposes.

C. umbraculifera, the Tala, or Talipat Palm, is a native of Ceylon, and similar in appearance; but its leaves are not so round as those of the Talliera, the divisions in the centre being shorter than those at the sides. The trunk grows 60 or 70 feet high; the leaves are 14 feet broad and 18 feet long, exclusive of this stalk, and they form a head about 40 feet in diameter. Fans of enormous size are manufactured from this plant in Ceylon; the pith of its trunk furnishes a sort of flour from which bread is made; the leaves make excellent thatch, and are also used for writing on, like those of the Talliera.

C. Gebanga is one of the most useful of all the Indian Palms. Its pith furnishes a sort of sago; its leaves are used for thatch and broad-brimmed hats; fishing-nets and linen shirts are woven from its fibres, and ropes from its twisted leaf-stalks; the root is both emollient and slightly astringent; sliced, it is used in slight diarrhœas, and Waitz says that it is a most valuable remedy for the periodical diarrhœas which in the East Indies attack Europeans.

CORYPHÆNA (Linnæus), a genus of Fishes belonging to the section *Acanthopterygii* and family *Scomberidæ*.

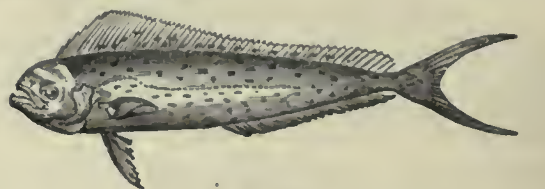
The group of fishes formerly included under the head *Coryphæna* is now subdivided, and the subdivisions may be either termed subgenera of the genus *Coryphæna*, or the group may be looked upon as a sub-family, and the subdivisions as genera. The principal characters of this group are as follows:—Body elongated, compressed, covered with small scales; dorsal fin extending the whole length of the back (or nearly so); branchiostegous rays generally seven in number. These fishes have commonly a long anal fin, in some extending from the tail almost to the ventral. The tail is more or less forked, and the pectoral fin is usually arched above and pointed.

Considering *Coryphæna* as a genus, the following are the sub-genera: —*Coryphæna* (proper), *Caranxomorus*, *Centrolophus*, *Astrodermus*, and *Pteraclis*.

Coryphæna.—The species have the head much elevated, and the palate and jaws both furnished with teeth.

These fishes are very rapid in their motions, usually of large size and they prey upon the flying-fish.

C. hippurus (Linn.), a species not uncommon in the Mediterranean, is about 2 feet in length, of a bluish-lead colour above and pale-yellow beneath. There are dark-blue spots on the back and dorsal fin, and the under parts of the body are furnished with spots of a paler colour. The ventral fins are yellowish beneath and black above, and the anal fin is yellowish. The greatest depth of the body is about one-sixth of the whole length.



Coryphæna hippurus.

There are several other species of this genus, some of which are found in the Mediterranean, and very closely resemble the one just described.

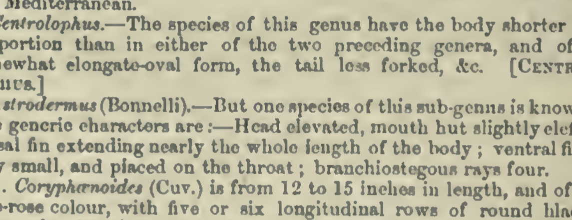
Caranxomorus (Lacépède) is closely allied to *Coryphæna* (proper); the species however may be distinguished by their having the head less elevated and the eye in a medial position; the dorsal-fin is shallow and of equal height throughout: the tail is much forked.

C. pelagicus is about 9 or 10 inches in length, of a bluish colour above and yellowish beneath; the dorsal and anal fins are of the same colour as the back of the fish, and have a whitish margin. It inhabits the Mediterranean.

Centrolophus.—The species of this genus have the body shorter in proportion than in either of the two preceding genera, and of a somewhat elongate-oval form, the tail less forked, &c. [CENTROLOPHUS.]

Astrodermus (Bonnelli).—But one species of this sub-genus is known. The generic characters are:—Head elevated, mouth but slightly cleft; dorsal fin extending nearly the whole length of the body; ventral fins very small, and placed on the throat; branchiostegous rays four.

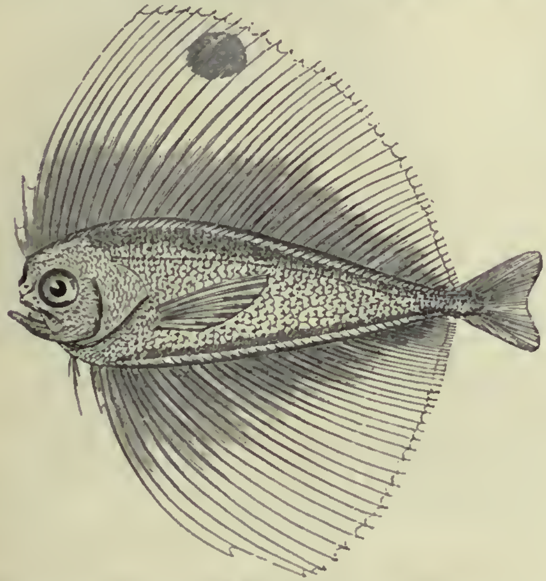
A. Coryphænoides (Cuv.) is from 12 to 15 inches in length, and of a pale-rose colour, with five or six longitudinal rows of round black spots; the dorsal and anal fins are blackish, and the pectoral and caudal fins are of a red hue. The most remarkable character of this fish however consists in the scales, which, instead of folding over each other in the usual way, are scattered over the body and head; they are very minute and serrated, and under a lens resemble small stars. It inhabits the Mediterranean.



Astrodermus Coryphænoides.

Pteraclis (Cuv.) The species of this group are remarkable for the immense size of the dorsal and anal fins, each of which springs from between two tiers of scales, which form a protection, and probably give strength to the basal portion of the fin-rays. These fins extend the whole length of the body; the head and teeth are nearly the same as in the true *Coryphænæ;* the scales are large.

P. ocellatus (Cuv.) is about 4 inches in length, and of a silvery hue; the pectoral and caudal fins are yellowish; the others are bluish-gray, and the dorsal fin has a large blue spot near its highest part.

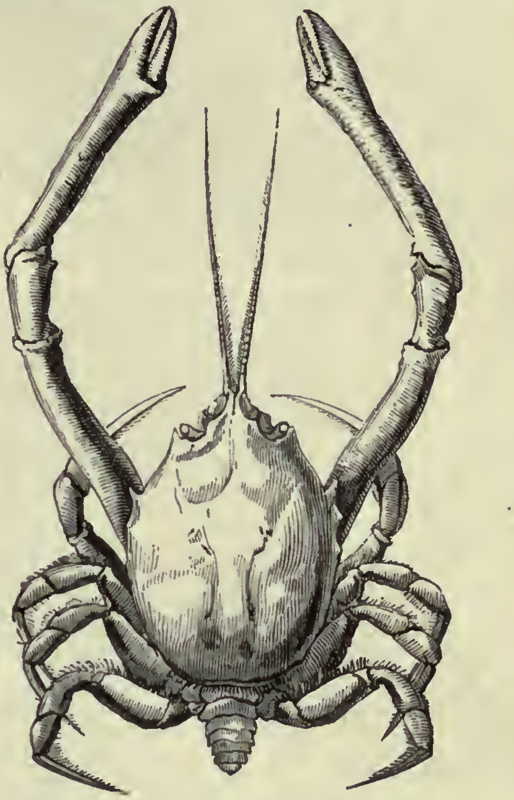


Pteraclis ocellatus.

CORYPHODON, a genus of Fossil Animals belonging to the family of Tapira. The remains of this genus have been found in this country; and although closely allied to the genus *Lophiodon* of Cuvier, Professor Owen regards its differences as of sufficient importance to constitute a new type. The specimen on which this genus was established is unique, and was dredged up from the bottom of the sea between St. Osyth and Harwich on the Essex coast, and now forms part of the collection of John Brown, Esq., of Hanway Green, near Colchester. This specimen is petrified, containing metallic salts, and having the appearance of fossils from the London Clay. There can be little doubt that it was originally imbedded in the Eocene Tertiary Formation of the Harwich coast. It consists of the right branch of the lower jaw, containing the last and part of the penultimate molar teeth of the lower jaw. Although this fragment resembles the same bone in the genus *Lophiodon*, yet a close examination of the crown of the last molar tooth exhibits a smaller antero-posterior diameter in proportion to its transverse diameter, as compared with the corresponding tooth in that genus. It also differs from the teeth of *Anthracotherium*, to which it has some resemblance. Professor Owen infers from this and other characters of these teeth that "the whole dental series of the extinct Eocene Pachyderms offered modifications of the Lophiodont type of dentition, which led towards that of the *Anthracotherium*, more especially of the smaller species from Garonne and Valery. From the closer resemblance which the fossil presents to the true Lophiodons, it must be regarded as a member of the same family of Tapiroid Pachyderms; indicating therein a distinct sub-genus, characterised by the want of parallelism of the two principal transverse ridges, and by the rudimental state of the posterior talon in the last molar tooth of the lower jaw. The name *Coryphodon*, which I have proposed for this sub-genus, is derived from χορυφή, a point, and ὀδοὺς, a tooth; and is significative of the development of the ridges into points. The broad ridged and pointed grinding surface of the tooth indicates its adaptation to comminute the coarser kinds of vegetable substances; and it is very probable that the habits and food of the Tapir, which is the nearest existing analogue of the *Coryphodon*, are not very dissimilar from those which characterised of old the present extinct species and the true Lophiodons."

Professor Owen gives the species the name of *Coryphodon Eocœnus.* He also describes a tooth found in digging for a well at Camberwell, at a depth of 160 feet in the Plastic Clay. After describing this tooth, Mr. Owen says, "From its close resemblance in the essential characters of its form to the canines of the great extinct Tapiroid Pachyderms, and the apparent specific distinctions from any of the known species of *Lophiodon*, I strongly suspect it to have belonged to a *Coryphodon.*" (Owen, *British Fossil Mammals and Birds.*)

CORYSTES, a genus of Brachyurous or Short-Tailed *Crustacea.* The species have the following characters:—Exterior antennæ longer than the body, setaceous, with two rows of cilia. Jaw-feet (pieds-machoires) having their third joint longer than the second, straight, terminated by an obtuse point, with a notch upon its internal border. Eyes rather distant, borne upon large peduncles, which are nearly cylindrical, and somewhat short. Anterior feet (chelæ) large, equal, twice as long as the body, and nearly cylindrical in the males; in the females, of about the length of the body, and compressed, especially towards the hand (manus). The other feet terminated by an elongated nail or claw, which is straight, pointed, and channeled longitudinally. Carapace oblong-oval, terminated by a rostrum anteriorly truncated and bordered posteriorly. The regions but slightly indicated, with the exception of the cordial region, the branchial or lateral regions being very much elongated.



Long-Clawed Crab (*Corystes Cassivelaunus*), male.

Corystes Cassivelaunus, female.

C. Cassivelaunus (Leach), the Long-Clawed Crab; *C. dentata, C. dentatus, C. longimanus*, of Latreille; *Cancer Cassivelaunus, Cancer personatus*, of Herbst; *Albunea dentata* of Fabricius.

This crab has the surface of the carapace somewhat granulous, with two denticles between the eyes, and three sharp points directed forwards on each side. The male has but five abdominal pieces; but, as M. Latreille observes, the vestiges of the separation of the two others may be clearly remarked upon the intermediate or third piece, which is the largest of all.

It is found on the coasts of England and France. The specimens figured by Pennant were dredged up from deep water near Holyhead and Red Wharf, Anglesey.

M. Desmarest is of opinion that the natural relations of his crustacean approximate it to *Atelecyclus*, *Thia*, and *Leucosia*, of which M. Latreille forms his Orbicular Tribe (Les Orbiculaires). Dr. Leach, he adds, in his method, placed them near the first two of the above-mentioned genera, solely because they have the same number of abdominal articulations. The *Leucosiæ*, in which the number of those articulations is less considerable, are removed to a distance.

COSCINO'PORA, a genus of Fossil Corals proposed by Goldfuss. *C. infundibuliformis* occurs in the Chalk of Ireland.

CO'SSONUS (Clairville), a genus of Coleopterous Insects belonging to the family *Curculionidæ*. It has the following characters:—Antennæ short, rather thick; funiculus 7-jointed, the basal joints longer than the following; club large and of an oval form; rostrum rather long, thickened at the apex; thorax truncated before and behind, and somewhat depressed above; elytra elongate, moderately convex above, and covering the abdomen; tibiæ dilated towards the apex, where there is a large hook; tarsi rather slender, the penultimate joint bilobed.

About seventeen species of this genus are known, of which Schönherr selects *C. linearis* as the type. This species is not uncommon in England, and has been found in *Boleti* and in old trees. It is about a quarter of an inch in length, and of a narrow elongated form, and black or brown colour; the elytra are punctate-striated. *C. tardus* is another British species which closely resembles the last, but is of a larger size, being nearly half an inch in length.

COSSUS (Fabricius), a genus of Insects belonging to the section *Lepidoptera nocturna*, Moths, and the family *Hepialidæ* (Stephens). The species have the following characters:—Antennæ long, rather slender, furnished on the inner edge with a series of transverse elevated ridges (which when viewed from the side resemble the teeth of a saw); two distinct palpi, thickly clothed with scales, and each 3-jointed; head very small; upper wings longer and larger than the lower; body large. Larva lignivorous. Pupa inclosed in a cocoon.

C. ligniperda (Fab.), the Goat-Moth, is one of the largest of the British moths, measuring from tip to tip of the wings when expanded from 3 to 3¾ inches. It is of a gray colour; the upper wings are mottled with white, and adorned with numerous irregular black lines; the under wings are almost of a uniform brownish-ash colour; the anterior part of the thorax is of a buff colour, and there is a transverse dark mark towards the posterior part; the body is of a dark brownish-gray colour, with rings of a silver-like hue.

The larva, or caterpillar, is about three inches in length when full-grown, and of a yellowish colour; the upper part of the body is pink, the head is black, and the first segment of the body (or that joining the head) has two irregular black patches above.

This caterpillar emits a very strong and disagreeable odour, and if touched with the hands the scent cannot be discharged from them for some considerable time, although they may be frequently washed. It resides in and feeds upon the wood of the poplar, oak, and aspen; but old pollard willows appear to be its most favourite haunts. These we frequently see perforated with numerous oval holes large enough to admit the finger, and when the caterpillars are abundant the trees attacked eventually fall a sacrifice to their ravages. It is three years before attaining maturity, at which time it incloses itself in a tough cocoon, formed of pieces of wood joined together by a glutinous web.

The moth is common in various parts of the south of England, and the name Goat-Moth has probably been applied to it from the property of emitting a disagreeable odour having been transferred from the caterpillar to the moth.

A detailed history of the *C. ligniperda* will be found in the 'Mémoires pour servir à l'Histoire des Insectes,' by De Geer; and for its anatomy we refer our readers to the 'Recherches sur l'Anatomie et les Métamorphoses de différentes Espèces d'Insectes,' by L. L. Lyonet. This latter author has also published a substantial quarto work, with numerous beautiful plates engraved and drawn by himself, which is entirely devoted to the anatomy of the caterpillar above mentioned. This work, which was the labour of years, must ever stand as a monument of the great skill and perseverance of its author, who boasts of having destroyed but one caterpillar for its completion. It is entitled 'Traité Anatomique de la Chenille qui ronge le Bois de Saule,' &c.

CO'SSYPHUS (Olivier), a genus of Coleopterous Insects of the section *Heteromera* and sub-section *Taxicornes*. The principal character of this genus consists in the dilated and flattened sides to the thorax and elytra—a structure also found in many of the *Nitidulæ* and in the *Cassidæ*. These insects, if it were not for the dilated portions of the thorax and elytra, would be of a long narrow form, but with these parts they present an oval outline. The thorax is nearly semicircular, and its dilated margins as well as those of the elytra are semitransparent. The antennæ are 11-jointed; the last four joints are considerably thicker than the preceding, and rather flattened; the terminal joint of the maxillary palpus is dilated, and of a somewhat triangular form; the head is completely hidden by the anterior part of the thorax.

These insects inhabit the south of Europe and the northern parts of Africa and India. About ten species are known.

C. Hoffmansegii is nearly half an inch in length, and of a dark brown colour; the parts of the thorax and elytra which extend beyond the insect itself are of a paler hue. It is difficult to give an accurate idea of this curious insect, which appears as if it were an ordinary shaped beetle pressed against the under side of a little oval scale of wax, so that its impression is distinctly visible above, being convex, whereas the scale itself is concave.

The present genus, with two others (*Helæus* and *Nilio*), form, according to Latreille, the second tribe of the family *Taxicornes*, and are included under the head *Cosyphenes*.

COTINGA. [CORACINA.]

COTONEASTER, a genus of Plants belonging to the natural order *Rosaceæ*, and to the tribe *Pomeæ*. The segments of the calyx 5; the petals 5; the styles 2-5; the fruit turbinate, its nuts adhering to the sides of the calyx, but not cohering at the centre; the stamens erect, as long as the teeth of the calyx. The species are shrubs, with simple entire leaves, woolly beneath. This genus was separated from *Mespilus* by Lindley.

C. vulgaris, the Common Cotoneaster. It has roundish ovate leaves, rounded at the base, flower-stalks and margins of the calyx downy; the petals are rose-coloured. It is a native of Europe, and is found in North Wales upon the cliffs at the Great Ormeshead. Previous to its having been discovered to be a British plant it had been cultivated in this country. Several varieties are met with both in a wild state and in gardens.

C. tomentosa has its peduncles and calyxes woolly. It is a shrub like the preceding, and is found wild on the rocks of the Jura and other parts of the Alps of Switzerland.

C. laxiflora has its flowers in panicled cymes, and its calyxes quite smooth. It has the same general appearance as *C. vulgaris*, and is probably a variety.

C. frigida is an East Indian species. It is a native of the higher mountains in the northern region of Nepaul.

C. affinis was brought from Chittong, a town of Lower Nepaul, and is similar in general appearance to the last species. *C. acuminata* and *C. nummularia* are likewise species from Nepaul.

C. rotundifolia and *C. microphylla* are probably varieties of the same species. They are both from the north of Hindustan.

All the species are adapted for shrubberies, and many of them are very commonly cultivated in Europe. They are easily propagated by laying down the branches, or by cuttings, which should be placed in a sheltered situation under a hand-glass. They may be also increased by dividing their roots, and by seeds.

(Lindley, *Linnean Transactions*; Loudon, *Arboretum et Fruticetum Britannicum*.)

COTTON, a word derived from *Kutn*, or *Kutun*, one of the names given by the Arabs to this substance, is a filamentous matter produced by the surface of the seeds of various species of *Gossypium*. [GOSSYPIUM.] It consists of vegetable hairs, of considerable length, springing from the surface of the seed-coat, and filling up the cavity of the seed-vessel in which the seeds lie. Hairs are extremely common on the surface of plants; frequently however they are unobserved, in consequence of their small number and minuteness; while on the other hand in some cases they give plants, such as the Mullein for instance, a remarkable hoary appearance. On the surface of seeds they are uncommon; and yet in the *Malvaceæ* and their allies, to which the cotton plants belong, they not only exist abundantly on the seeds of that genus, but in several other species. Vegetable hairs are one of the many forms in which the cellular substance of vegetation is developed, and they consequently partake of two of the great characteristics of that form of tissue, namely, thinness and transparency. In the cotton they are long weak tubes, which, when immersed in water and examined under the microscope by transmitted light, look like flat narrow transparent ribands, all entirely distinct from each other, and with a perfectly even surface and uniform breadth. At certain distances along the hair, an interruption occurs, which looks as if it proceeded from the turning round or twisting of the hair during its growth. On each side opposite these interruptions a slight indentation is observed. Sometimes a slight trace of fine grains is discernible in the interior, but more frequently the hairs seem empty. If strained singly they have little strength and readily break, and it is only when many are entangled together that they acquire any appreciable degree of strength. In all these points cotton differs from the vegetable matter that constitutes linen; the latter consists of woody tissue, in the state of long tubes, but is at once distinguished by the tubes adhering in bundles, which it is difficult under a microscope to break up into their component parts; the tubes are thick-sided, and will not acquire a riband-like appearance when viewed in water, but rather resemble extremely minute thermometer tubes. When they are jointed together the articulation is oblique, the ends of the tubes being pointed and overlying each other; and finally, in each particular tube of the woody tissue, delicate as it may be, there is a sufficiently appreciable degree of toughness when an attempt is made to break it. In short, cotton is a development of cellular tissue. Linen is a form of vascular tissue. Hence it is easy to distinguish with certainty linen from cotton manufactured articles, in cases of doubt; and hence also the well-known superiority of linen to cotton in strength: the latter is manufactured from the most delicate part of plants, the former from the toughest. [TISSUES, VEGETABLE.]

Cotton is produced by many different species and varieties of the genus *Gossypium*, which consists of herbaceous or nearly herbaceous plants, varying in height from 3 or 4 to 15 or 20 feet, according to the sort. Sometimes the branches become woody, but they always partake very much of the herbaceous character. The leaves are downy and more or less lobed, being sometimes however near the top of the stem undivided; at their base is seated a pair of awl-shaped stipules. The flowers are either yellow or dull purple, and have the ordinary structure of the Malvaceous Family; each is surrounded by three heart-shaped bracts, which are more or less lacerated. The calyx is a bluntly 5-toothed cup. The seed-vessel is a capsule opening into from 3 to 5 lobes, and then exposing many seeds enveloped in cotton, which sometimes adheres to them so firmly that it is separated with difficulty; sometimes it parts freely from them; in some sorts it is long and in others comparatively short, giving rise to the commercial names of Long Staple and Short Staple.

The qualities of these hairs most valued by the manufacturer are length of staple, strength, and silkiness. In these respects cotton differs very much, and it is when these three properties are combined in the highest degree that the cotton obtains the highest prices in the markets.

Cotton-plants are found wild in both the Old and New World. Herodotus and Arrian speak of the cotton-plant as indigenous in India, and the cloth found in Peruvian tombs sufficiently attests its having existed in that country long before it could possibly have been carried to America by eastern intercourse. In fact the wild American cotton-plants are specifically different from those of the Old World; but at the present day the cotton of the West is cultivated in Asia and Africa, while that of the East has long since been introduced to the American plantations.

The situations in which cotton-plants have been advantageously cultivated are included between Egypt and the Cape of Good Hope in the eastern, and between the southern banks of the Chesapeake Bay and the south of Brazil, in the western hemisphere. It has not been found to succeed beyond the parallels that limit those countries. In the equinoctial parts of America Humboldt found it at 9000 feet elevation above the sea; in Mexico as high as 5500 feet; and Professor Royle saw it at the elevation of 4000 feet on the Himalayas. It seems generally to prefer the vicinity of the sea in dry countries, and the interior districts of naturally damp climates. Thus, while the best cotton is procured in India from the coast of Coromandel, or other maritime districts, and in the southern states of the American Union from certain coast-islands, the coast cotton of Pernambuco is inferior to what is produced in the interior of that country. These facts lead to the inference that it is not merely temperature by which the quality of cotton is affected, but a peculiar combination of heat, light, and moisture; the most favourable instance of which may be assumed to be the coast of Georgia and the Carolinas, and the worst to be Java and the coast of Brazil.

That this should be so would, in the absence of positive evidence, be probable, considering the nature of cotton. We have seen that it is a hairy development of the surface of the seed; and nothing in the organisation of plants is more affected by the situation they live in than their hairs: thus many water-plants which have scarcely any hairs, when transferred to a dry exposed station are closely covered with such organs, and *vice versâ*. The quantity of hair is also affected in an extraordinary degree by local circumstances. The Venetian sumach-plant, when in flower, has its flower-stalks nearly naked; a large proportion of the flower-stalks has no fruit, and becomes covered with very copious long hairs, whence the French call this plant Arbre à Perruque; but those flower-stalks which do bear fruit remain hairless. In this case the local cause is probably the abundant food thrown by the system of the sumach-plant into the flower-stalks for the nourishment of the fruit; and the fruit not forming, the food intended for it is expended in the formation of hairs upon the surface of the flower-stalk. This is only an accident, but local circumstances conducive to the formation of cotton in excess may be permanent, and derived from the situations in which the plants grow. In a damp cloudy climate the food procured from the soil may not be concentrated upon the surface of the seed, but may be expended in the production of excessive quantities of leaves, and of proportionally few flowers; or it may pass off into the atmosphere in the form of a mere exhalation, a small proportion only being consolidated; or in a dry climate the soil may not be able to furnish food enough to the plant out of which to form more cotton than it is absolutely its specific property to produce under any circumstances. Or, lastly, there may be a mean where the powers of vegetation are called into their utmost activity by warmth and abundant food, and where, nevertheless, the dryness of the atmosphere and the brightness of the sun, constantly acting upon the surface of the cotton pods (seed-vessels), may drive back the juices from the surface of the latter to that of the seeds, and thus augment the quantity and improve the quality of the cotton itself: this may explain the action of climate upon this substance.

The question is however rather more complicated; the different specific qualities of different varieties of the cotton-plant must be also taken into account. A considerable number of varieties of cotton is certainly cultivated, although little is correctly known about them. In some of them the cotton is long, in others it is short; this has it white, that nankeen-coloured: one may be cultivated advantageously where the mean winter temperature does not exceed 46° or 48°, and another may require the climate of the tropics. This is just what happens with all cultivated plants. Some vines will produce only sweet wine, others only hard dry wine, and some are suited only to the table; some potatoes are destroyed by a temperature of 32°, while others will bear an average English winter; only one kind of wheat produces the straw from which the fine Leghorn plait for bonnets is prepared. But to multiply such instances is unnecessary. There can then be no doubt that the quantity and quality of cotton will depend partly upon climate and partly upon the specific properties of particular varieties.

The Cotton-Plant, or *Gossypium*, must not be confounded with the Cotton-Tree, *Bombax*, or *Eriodendron*. The latter has also cottony seeds, but they cannot be manufactured.

For further information see COTTON MANUFACTURE, in ARTS AND SC. DIV.

(Royle, *Illustrations of the Botany and other Branches of the Natural History of the Himalayan Mountains, and of the Flora of Cachmere*, article 'Malvaceæ.')

COTTUS (Linnæus), a genus of Fishes belonging to the section *Acanthopterygii* and family *Loricati* (Jenyns). The species have the following characters:—Head large, depressed, furnished more or less with spines or tubercles; teeth in front of the vomer and in both jaws, none on the palatines; two dorsal fins; ventral fin small; body without scales; branchiostegous rays six.

C. gobio, (Linn.), the River Bull-Head, Miller's Thumb, or Tommy-Logge, affords an example of this genus. This little fish, which is found in almost all the fresh-water streams throughout Europe, is from 3 to 4 inches in length, and of a browish colour above, more or less mottled and spotted, and whitish beneath. The head is very large in proportion to the body, and without spines; the pre-operculum has a single curved spine on the posterior part: the eyes are small, and directed upwards. The number of fin-rays are—anterior dorsal 6 to 9, posterior 17 or 18; pectoral 15; ventral 3; anal 13; caudal 11. The name Bull-Head is given these fishes on account of the large size of their heads. These fish more particularly frequent those streams in which pebbles abound. They feed upon aquatic insects, &c. It is found in the brooks and streams of Great Britain.

The remaining British species of this genus inhabit the salt water, and together with others of the same habits, are distinguished from the fresh-water species by having the head armed with numerous spines.

C. scorpius (Bloch), the Sea-Scorpion, or Short-Spined Cottus, is very common on our coasts, and is found very frequently under stones or sea-weeds, in the little pools left by the retiring tide. It is thus described by Mr. Yarrell. "The head large, more elevated than that of the River Bull-Head; upper jaw rather the longer; teeth small and sharp; eyes large, situated about half-way between the point of the nose and the occiput; irides yellow, pupils bluish-black; one pair of spines above the nostrils, with an elevated ridge between them; the inner edges of the orbits elevated, with a hollow depression above, but no occipital spines; pre-operculum with three spines; the upper one the longest; operculum with two spines, the upper one also the longest, the lower one pointing downwards; there is besides a scapular and a clavicular spine on each side; gill-openings large; the body tapers off rapidly, and is mottled over with dark purple-brown, occasionally varied with a rich red-brown; the belly white; the first dorsal fin slightly connected with the second by an extension of the membrane; lateral line smooth; the ventral fins attached posteriorly by a membrane to the belly." Length rarely exceeding 8 or 9 inches.

This fish feeds upon small *crustacea* and the fry of other fishes.

C. bubalis (Euphrasen), the Father-Lasher, or Long-Spined Cottus, is about the same size, and resembles the last both in appearance and habits; the two species however are seldom found in the same immediate neighbourhood. This species is distinguished from the last by its more perfectly armed head, the spines of which are longer in proportion, the space between the eyes is less, the crest above the eyes is more elevated, and the ventral fins are destitute of the connecting membrane observed in the Short-Spined Cottus. Both these and the last species are remarkable for the length of time they will live out of the water. Hence Mr. Yarrell concludes that it is not a large gill-aperture, as has been supposed, which hastens the death of certain kinds of fish, as these have very large heads and gill-apertures.

C. quadricornis (Linn.), the Four-Horned Father-Lasher, or Cottus, another species also found off the British coast, though less abundantly than either of the foregoing maritime species, may be distinguished, as its name implies, by the four tubercles which are situated on the top of the head, two on the nape, and two near the eyes; the pre-operculum is furnished with three spines, and the operculum with one; length from 10 to 12 inches.

Aspidophorus, Lacépède, is considered by Cuvier as a sub-genus of *Cottus*. This genus, or sub-genus, is thus characterised:—Head large and depressed, more or less armed with spines and tubercles; both jaws furnished with teeth, none on the vomer; body attenuated posteriorly, covered with angular plates; ventrals small; branchiostegous rays six.

A. Europæus (Cuvier), the Armed Bull-Head, Pogge, Lyric, Sea-Poacher, Pluck, or Noble. This little fish, generally about 4 or 5 inches in length, is frequently caught in the shrimping nets, and is called by the fishermen, in some districts, in addition to its other names, the Hook-Nose. Its general covering is brown above and white beneath: there are however most commonly indications, more or less distinct, of several broad dark marks across the back; the nose is furnished with four recurved spines; the upper jaw extends beyond the lower; the infra-orbitals have three blunt tubercles on their lower margin, and a sharp spine directed backwards; the pre-operculum is also armed with a spine; the branchiostegous membrane and chin are each furnished with numerous fleshy filaments; the body is divided longitudinally by eight scaly ridges, those on the upper part being most produced. The number of fin-rays are—dorsal 5 to 7; pectoral 15; ventral 3; anal 7; caudal 11.

The habits of this fish appear in many respects to be the same as those of the *C. scorpius*, &c. It is very frequent on the southern shores of Great Britain.

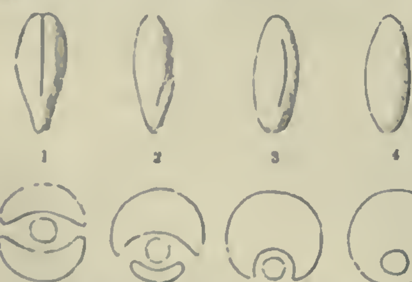
COTUNNITE, a Mineral. It is a native Chloride of Lead, occurring on Vesuvius in white acicular crystals.

COTURNIX. [Tetraonidæ.]

COTYLEDON is the leaf of a seed; it is the part prepared by nature to enable the young plant when it first springs into existence, and before it has been able to form organs of digestion and respiration, to perform both those functions. Sometimes the cotyledon performs these functions under ground during the whole period of its activity; but in many cases its subterranean life extends only to a few days or hours, after which it is elevated above the soil, and takes on the ordinary property of the leaves. [Germination.]

The situation of the cotyledon is on one side of the axis, of which the plumule is the apex, and the radicle the base. In the largest number of known seeds there are two cotyledons on opposite sides on the same plane; in a few there are several opposite to each other in a whorl; in a considerable number there is only one; and among the lower plants there appears to be an absence of any distinct organ of this kind. These differences have given rise to the terms Dicotyledons, Polycotyledons, Monocotyledons, and Acotyledons.

The first two and the last of these forms will be readily understood; but the structure of a Monocotyledon is far more puzzling to the student, in consequence of the axis not being found on one side of the cotyledon, as would have been expected. A common monocotyledonous embryo is a nearly cylindrical body, obtuse at each end, as at *fig.* 4, and its axis of growth is in the interior of the cotyledon, so that it can only be found by cutting the organ open. The following diagram will explain this anomaly. Let the upper line represent four kinds of embryoes seen from the side, and the lower line the plan upon which those embryoes are constructed, the inner circle being always the axis of growth, and the crescent or crescents the cotyledons. *Fig.* 1 is a common dicotyledonous embryo, with its cotyledons equal; *fig.* 2 is a rare kind of embryo of the same kind, with one of the cotyledons exceedingly small. If the smaller cotyledon were absolutely deficient, it may easily be conceived that such an embryo as that at *fig.* 3 would be the result, the angles of the crescent being drawn together round the axis, just as the edges of leaves are drawn together when they roll up in the leaf-bud. If we now suppose that the angles are not only drawn together, but actually united as at *fig.* 4, the presence of the axis within the cotyledon will no longer appear inexplicable.



COTYLEDON, a genus of Plants belonging to the natural order *Crassulaceæ*. It has 5 sepals shorter than the tube of the corolla; the petals cohering in a tubular 5-cleft corolla; the stamens 10, inserted on the corolla; 5 hypogynous scales; 5 carpels. The species are succulent shrubs, mostly natives of the Cape of Good Hope.

C. umbilicus, Navel-Wort, has the lower leaves peltate, concave, orbicular; the bracts entire; flowers pendulous. The flowers are of a greenish-yellow colour, and the stem is from 6 to 12 inches high. It is found very commonly on rocks or walls in the west of England. It is also a native of Portugal. Although this plant belongs to an order with comparatively inert properties, it has obtained a reputation in the treatment of nervous diseases, especially epilepsy.

C. lutea has the lower leaves somewhat peltate, upper leaves crenate or toothed, the bracts toothed, flowers erect. The flowers are of a bright yellow. It has been found wild in England, but is probably not a native.

Many of the species of this genus have been separated under the genus *Umbilicus*, the type of which is the first species named—which is called *U. erectus*. The species of *Umbilicus* closely resemble those of *Cotyledon*. In the cultivation of the species of both genera, they should be placed in pots well drained, with a soil of sandy loam or brick rubbish. They may be propagated by cuttings, which should be laid to dry for a few days after they have been cut off, before they are planted, as they are apt to rot at the wound if otherwise treated. The best situation for these plants is the shelves of a greenhouse.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*.)

COUA. [Cuculidæ.]

COUAGGA. [Equidæ.]

COUCH-GRASS. [Triticum.]

COUMAROUNA, a genus of Plants belonging to the natural order *Leguminosæ*. It has 8 stamens, and the lower segment of the calyx undivided. This genus is also referred to *Dipterix*.

C. odorata is the plant which yields the sweet-scented Tonga Bean of the perfumers. It is a native of French Guyana, where it forms a large forest-tree, called by the natives Coumarou. The trunk is said to be 60 or 80 feet high, with a diameter of 3½ feet, and to bear a large head of tortuous stout limbs and branches. The leaves are pinnated, of two or three pairs of leaflets, without an odd one at the extremity. The flowers appear in axillary branches, and consist of a calyx with two spreading sepals, and five purple petals washed with violet, of which the three upper are the largest and most veiny. The stamens are eight, and monadelphous. The fruit is an oblong hard dry fibrous drupe, containing a single seed; the odour of its kernel is extremely agreeable. The natives string the seeds into necklaces; and the Creoles place them among their linen, both for the sake of their scent and to keep away insects.

Sweet-Scented Tonga (*Coumarouna odorata*).

1, a ripe drupe; 2, the same cut open; 3, a complete flower; 4, the calyx with a young drupe projecting from it.

COURSER. [Cursorius.]

COUZERANITE, a Mineral from the Pyrenees. It has a composition near to that of *Labradorite*. [Labradorite.]

COW. [Bovidæ.]

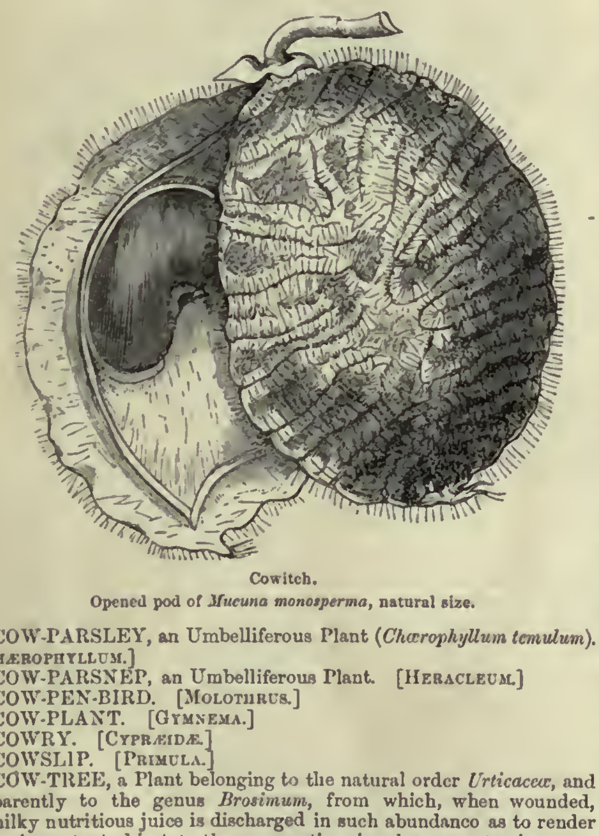
COWBANE, one of the common names for the Water-Hemlock. [Cicuta.]

COW-BERRY, a common name for the Red Whortleberry. [VACCINIUM.]

COW-BUNTING. [MOLOTHRUS.]

COWITCH, or COWAGE, a word of unknown derivation, unless it be a corruption of Al Kooshee, the Bengâli name of one of the plants that produces it, consists of the hairs found upon the pods of different species of *Mucuna*. They are exceedingly slender, brittle, and easily detached, and the fragments readily stick into the skin and produce an intolerable itching; hence they are frequently employed for mischievous purposes. Cowitch is also used medicinally as a vermifuge, by being mixed with syrup till of the consistence of honey, and given in doses of two or three tea-spoonfuls.

The plants that bear these pods are large twining annuals or perennials, with leaves like those of kidney-beans, being dark purple papilionaceous flowers, with a short standard lying close upon the wings and keel, and diadelphous stamens, half of which have round and half arrow-headed anthers. The pods contain from one to six seeds, and are covered by a very wrinkled shriveled skin, which even stands up in little plates. Before they are ripe and their hairs hardened, the pods are employed as a vegetable, like kidney-beans, and are described as being delicious. The species are found in hedges, thickets, on the banks of rivers, and about watercourses in both the East and West Indies, and America within the tropics. *Mucuna urens* and *M. pruriens* usually furnish the substance; but that from *M. monosperma*, called by the Telingas Enooga dola Gunda, or Elephant's Scratch-Wort, is said to exceed the others in the irritating burning property of its hairs. Dr. Roxburgh states that *M. pruriens* was one of the plants formerly used in India to poison wells; "it has turned out, however, not to be the poison it was taken for, and it is more than likely that the other plants employed for the same base ends are fortunately much less dangerous than those who employ them imagine." [MUCUNA.]



Cowitch.
Opened pod of *Mucuna monosperma*, natural size.

COW-PARSLEY, an Umbelliferous Plant (*Chærophyllum temulum*). [CHÆROPHYLLUM.]

COW-PARSNEP, an Umbelliferous Plant. [HERACLEUM.]

COW-PEN-BIRD. [MOLOTHRUS.]

COW-PLANT. [GYMNEMA.]

COWRY. [CYPRÆIDÆ.]

COWSLIP. [PRIMULA.]

COW-TREE, a Plant belonging to the natural order *Urticaceæ*, and apparently to the genus *Brosimum*, from which, when wounded, a milky nutritious juice is discharged in such abundance as to render it an important object to the poor natives in whose country it grows. It is described by Humboldt as being peculiar to the Cordilleras of the coast of Caracas, particularly from Barbula to the lake of Maracaybo, near the village of San Mateo, and in the valley of Caucagua, three days' journey east of Caracas. In these places it bears the name of Palo de Vaca, or Arbol de Leche, and forms a fine tree resembling the Star-Apple of the West Indies. "Its oblong pointed leaves, rough and alternate, are marked by lateral ribs, prominent at the lower surface, and parallel; they are, some of them, ten inches long." Its flowers and fruit have not been seen by any botanist. From incisions in its trunk flows a glutinous milk, similar in consistence to the first milk yielded by a cow after calving. It has an agreeable balsamic smell, is eaten by the negroes, who fatten upon it, and has been found by Europeans perfectly innocuous. In chemical characters it is remarkably similar to the milk of animals, throwing down a cheesy matter, and undergoing the same phenomena of putrefaction as gelatine.

Humboldt supposed the Cow-Tree to belong to the Sapotaceous Order; but, though little has been added to our knowledge of it since his visit to the Caracas, it is at least certain that it is either a species of *Brosimum* or very nearly related to it, and consequently a member of the Urticaceous Order.

The latter circumstance renders the Cow-Tree still more interesting; for the milky juice of Urticaceous plants is in other cases highly poisonous. But botanists are now acquainted with many instances of innocuous plants in poisonous orders; thus the Hya-Hya Treo of Demerara, for instance, belonging to the deadly Apocynaceous Family, yields a thick rich milky fluid destitute of acrimony; and the Kiriaghuna plant of Ceylon is a sort of East Indian Cow-Plant, notwithstanding it belongs to the Asclepiadaceous Order, which is acrid and dangerous. In the absence of precise information as to the circumstances under which the Cow-Trees are milked, it is impossible to say what is the cause of their harmlessness; but every physiologist will see that it is capable of being explained without difficulty in more ways than one.

COYPU. [MYOPOTAMUS.]

CRAB. [CANCER; CRUSTACEA.]

CRAB-APPLE, or WILD APPLE. [PYRUS.]

CRABRO'NIDÆ (Leach), *Crabronites* (Latreille), a family of Hymenopterous Insects of the section *Aculeata* and sub-section *Fossores*. The species have the following characters:—Head large, and appearing almost square when viewed from above; body oval or elliptical, narrowed more or less at the base, and joined to the thorax by a peduncle; antennæ short, and generally thickened towards the apex.

According to Latreille, the following genera are included in this family:—*Tripoxylon, Gorytes, Crabro, Stigmus, Pemphredon, Mellinus, Alyson, Psen, Philanthus*, and *Cerceris*.

The species of *Tripoxylon* provision their nests with small spiders. The species of *Gorytes* are parasitic.

The species of the genus *Crabro* are chiefly distinguished by their having but one perfect cubital cell to the anterior wing; the mandibles terminating in a bifid point, and the antennæ being distinctly geniculated, they are sometimes filiform, and sometimes slightly serrated. The palpi are short, and almost equal. The clypeus is frequently clothed with a fine down of a glossy silver-like hue.

These insects are extremely active in their movements, and may be frequently seen settling on the flowers of umbelliferous plants, on palings, or on the leaves of plants when the sun is shining upon them, lying wait in such situations for the approach of other insects, which they seize and carry to their nests for the purpose of feeding their larvæ. The larger species of this country are mostly of yellow and black colours, the body being adorned with rings of the former colour, the smaller species are for the most part black.

Crabro cephalotes is upwards of half an inch in length; black; the body is adorned with five yellow rings; the basal joint of the antennæ and the tibiæ and tarsi are also yellow.

Crabro patellatus (Panzer), and several other species of this genus, are remarkable in having a large appendage attached to the external part of the anterior tibiæ; this is a thin plate of a somewhat rounded form, convex above and concave beneath, and is undoubtedly used in removing the soil whilst these insects are forming their burrows in the ground. Each burrow is stored with flies or other insects (depending upon the species of *Crabro* to which it belongs); the eggs are then deposited with these flies, which constitute the food of the larvæ when hatched. Many species of *Crabro* form their cells in rotten trees or posts. Much that relates to the habits of these insects however remains to be discovered.

CRA'CIDÆ (Vigors), a family of Rasorial or Gallinaceous Birds (*Rasores*). Mr. Vigors regarded this family as connected with the Struthious Birds, *Struthionidæ* (Ostrich Family), by means of the Dodo [DODO], generally supposed to be now extinct, the foot of which, he observes, has a strong hind toe, and which, with the exception of its being more robust, in which character it still adheres to the *Struthionidæ*, corresponds exactly with the Linnæan genus *Crax*. "The bird," says Mr. Vigors, "thus becomes osculant, and forms a strong point of junction between these two conterminous groups, which, though evidently approaching each other in general points of similitude, would not exhibit that intimate bond of connection which we have seen to prevail almost uniformly throughout the neighbouring subdivisions of nature, were it not for the intervention of this important genus."

"The family of *Cracidæ*," says Mr. Vigors, "thus connected with the *Struthionidæ*, are separated from the typical groups of the order by the length and robustness of the hinder toe, and by its being situated more nearly on a level with those in front. These birds, placed in this manner at the extreme of the present order, assume more of the habits and appearance of the preceding order of Perchers than the other *Rasores*, with the exception of the family of *Columbidæ*. They are found most frequently to make their abode in trees, and to resort to the neighbourhood of forests: in the lesser number of their tail-feathers they evince an equal deviation from their more typical congeners, and they never possess a spur. This family contains the

Ourax of M. Cuvier, and the true *Crax*, Linn., together with the *Penelope* and *Ortalida* of M. Merrem. The two latter genera have their hind toe articulated on a level with the front toes, and thus reconduct us to the *Columbidæ*. Their bills also, more lengthened than those of *Crax*, approach most nearly to those of the Pigeons, which, on the other hand, seem to meet them by the stronger form and curvature of the bill of *Vinago*, which deviates in these particulars from the general structure of its own family. The genus *Ortalida*, in particular, the feathered cheeks of which are distinguished from the naked face of *Penelope*, brings us in immediate contact with that family. Here it is, in this extreme of the order, that I would assign a place to the beautiful New Holland genus *Menura*, Lath., a group that has hitherto afforded more difficulty to the systematic writer than any other in the class. By modern authors it is generally placed among the Perchers on account of the length and low position of the hind toe. But its habits and manners are gallinaceous, as far as we can ascertain, and its general appearance decidedly evinces an affinity to the *Rasores*. The deviation in the structure of the foot from that of the typical Rasorial groups only indicates its being placed at a distance from them, and in that extreme of the order which connects itself with the conterminous order of Perchers. The same deviation, it has been seen, is found in other groups of its own family, and in the adjoining family of *Columbidæ*. A group newly discovered in some islands of the Eastern Archipelago, the *Megapodius* of M. Temminck, serves strongly to illustrate these principles, and to corroborate my opinion as to the situation of the singular New Holland genus before us. The *Megapodius*, brought home to France by one of her late expeditions, is confessedly gallinaceous in its habits, and as such has been placed, without hesitation, among the true *Rasores*, and yet its foot is precisely of the same construction as that of *Menura*. The bill also shows no very material difference from those of the extreme groups of the *Cracidæ*. To return however to the general affinities of the family, it may again be repeated that all the latter genera thus united among themselves, evince an evident approach to the *Columbidæ*, from which, it may be remembered, we commenced our observations on the order. The whole of the groups of the *Rasores*, thus following each other in continued affinity, preserve their circular succession without interruption." [MENURA.]

The following are the characters of the Family:—Three toes before, one behind, the latter touching the ground throughout. Head feathered, generally crested: there is often a cere or naked skin at the base of the bill.

Mr. Swainson, 'Natural History and Classification of Birds,' vol. i., p. 153, states, that "In the family of the *Cracidæ*, which connects the *Insessores* with the *Rasores*, the hinder toe is nearly as long as in the cuckoos, and is considerably more developed than in any other group of rasorial birds. We will say nothing of the genera *Megapodius*, *Palamedea*, and *Menura*, whose feet are well known to be enormous; or of *Opisthocomus*, because specimens of these large and rare birds are not upon our table. Confining ourselves to the genus *Penelope*, we may remark that the toes, considered by themselves, might be taken for those of a cuckoo, if the outer one was only versatile; it is evident also, from the structure of the claws, that these birds are much more arboreal than their congeners, for their claws are more curved; and from their lateral and not horizontal compression, as well from their acuteness, we conclude that they are very little, if at all, employed in scratching the ground, their structure being similar to those of Perchers, and adapted only for clinging. The foot, in fact, of the *Penelope*, is not a rasorial but an insessorial foot, for it does not possess any one of the rasorial characters. Even the hind toe, which in all other rasorial birds is raised above the heel, is here placed upon the same level as the anterior toes. That no ambiguity should rest on this fact, we beg to call the ornithologist's attention to the particular species now before us, the *P. Aracuan* of Spix, one of the most common of the same genus. How this remarkable formation in the foot of the typical *Cracidæ* should hitherto have been completely overlooked, even by those who have speculated so much on the mode by which the *Rasores* and *Insessores* are united, is somewhat extraordinary. We can only account for it by the custom of examining specimens set up in cases, or on branches, instead of preserving them in skins, in which state they can be handled in all directions. But however this may be, the fact itself decides the long-contested question as to which family of the *Rasores* makes the nearest approach or rather forms the passage to the *Insessores*; while, if this question be reversed, and it is asked which of the *Insessores* makes the nearest approach to the *Rasores*, we need only direct our search among some of the long-legged Brazilian cuckoos, or at once point to the singular genus *Opisthocomus*."

Ourax (*Pauxi*, Temm.).—Bill short, strong, compressed, vaulted, convex, dilated at the base of the upper mandible into a horny, oval, hard, and elevated substance. Nostrils basal, pierced near the front, hidden, open beneath; head covered with short and close-set feathers. Feet (tarsi) long and smooth. This family consists of the following genera:—

O. Pauxi (Cuv.), the Galeated Curassow. Size about that of a small hen turkey. Head and neck covered with short velvety feathers of a rich black. All the rest of the plumage, with the exception of the white abdomen and under tail-coverts, brilliant black, exhibiting in certain positions a slight tinge of green. Tail-feathers tipped with white. Legs red, claws yellow. Iris brown. Bill bright red: the protuberance with which it is surmounted (which is rounded in the young birds, and pear-shaped with the narrow end directed forwards in the adult males) of a livid slate-colour; it is more than two inches in length when fully developed, hard and bony externally, and internally cellular, the cells communicating with the cavity of the mouth. This protuberance is not visible till after the first moulting, when it first appears in the form of a small tubercle, and becomes much larger in the male than in the female. In other respects there is little difference between the sexes, and the young are only distinguished by a browner tinge. The windpipe descends for a considerable distance in front of the sternum, immediately beneath the skin, and makes no less than three distinct convolutions before passing into the cavity of the chest. (E. T. Bennett.)

Galeated Curassow (*Ourax Pauxi*).

This bird is a native of Mexico, where the species lives in large companies perching upon the trees. Nest generally made on the ground. The young are led about by the female in the same manner as the hen pheasant and the common hen lead theirs. The first food of the chicks consists of worms and insects, but as they advance fruits and seeds are added. Hernandez gives a very good description of the bird in his 'Historia Avium Novæ Hispaniæ,' cap. ccxxii. The Galeated Curassow is easily domesticated, and is enumerated by M. Temminck among the birds which bred abundantly in the menagerie of M. Ameshoff before the French revolution.

Mr. Yarrell has pointed out the peculiarities of the very elongated trachea of another species, *Ourax Mitu*, Cuvier. This organ is produced between the skin and the muscles beyond the sternum, and reaches almost to the vent. It has been figured by Dr. Latham, M. Temminck, and others. The sterno-tracheal muscles extend along the whole of the tube, a disposition which, Mr. Yarrell remarked, prevails with one or two exceptions in all birds in which the fold of the trachea is not included in the bone. ('Zool. Proc.,' 1830-31.) Mr. Bennett ('Gardens and Menagerie of the Zoological Society') observes that the nostrils in *Ourax Pauxi* are seated behind the protuberance, and are perpendicular in their direction: the membranous cere which surrounds them, he adds, is covered with short velvety feathers.

Crax.—Bill moderate, long, compressed, higher than it is broad at the base, thick, carinated above, curved towards the end, surrounded at the base with a membrane; lore naked; nostrils lateral, longitudinal, pierced in the cere, and partially covered. Head crested with curled feathers. Tail spread out, inclined; tail-feathers 14. Sixth quill the longest. Hallux reaching the ground with the first phalanx.

C. Alector (Linnæus), the Crested Curassow. The plumage of the Crested Curassow is of a deep black, with a slight gloss of green upon the head, crest, neck, back, wings, and upper part of the tail; it is of a dull white beneath, and on the lower tail-coverts. Its crest is from 2 to 3 inches in length, and occupies the whole upper surface of the head; it is curled and velvety in its appearance, and capable of being raised or depressed at will. The eyes are surrounded by a naked skin which extends into the cere, and there assumes a bright yellow colour. Size about that of *Ourax Pauxi*. (E. T. Bennett.)

"This species," says Mr. Bennett, "is a native of Mexico, Guyana, and Brazil, and probably extends itself over a large portion of the southern division of the American continent. In the woods of Guyana it appears to be so extremely common that M. Sonnini regards it as the most certain resource of the hungry traveller whose stock of provisions is exhausted, and who has consequently to trust to his gun for furnishing him with a fresh supply. They congregate together in numerous flocks, and appear to be under little or no uneasiness from the intrusion of men into their haunts. Even when a considerable number of them have been shot the rest remain quietly perched upon the trees, apparently unconscious of the havoc that has been com-

Crested Curassow (*Crax Alector*).

mitted amongst them. This conduct is by no means the result of simplicity, but proceeds rather from the natural tameness and unsuspiciousness of their character. Those however which frequent the neighbourhood of inhabited places are said to be much wilder and more mistrustful, being kept constantly on the alert to avoid the pursuit of the hunters, who destroy them in great numbers. They build their nests on the trees, forming them externally of branches interlaced with the stalks of herbaceous plants, and lining them internally with leaves. They generally lay but once a year, during the rainy season; the number of their eggs being, according to Sonnini, five or six, and according to D'Azara as many as eight. They are nearly as large as those of a turkey, but are white like a hen's, and with a thicker shell." ('Gardens and Menagerie of the Zoological Society,' vol. ii.)

C. Yarrellii, the Red-Knobbed Curassow. The trachea of this species differs from all those previously known, but most resembles that of *C. Alector*, Linnæus, while in external characters the bird approaches *C. globicera*, Linnæus, from which it is distinguished by the redness of its cere, and by a prominence on each side under the base of the lower jaw, in addition to the globose knob near the base of the upper. The tube in *C. Yarrellii* is straight throughout its whole length, except a short convolution imbedded in a cellular membrane placed between the shafts of the os furcatorium. The trachea is narrow, and the fold, invested and supported by a membranous sheath, gives off one pair of muscles, which are inserted externally below the apex of the os furcatorium. The lower portion of the tube immediately above the bone of divarication sends off a pair of muscles to be inserted in the sternum. The upper pair of muscles (furculo-tracheal) influence the length of the tube above the convolution. The inferior pair (sterno-tracheal) have the same power over the bronchial tubes and that portion of the trachea which is below the convolution. ('Zool. Proc.,' 1830-31.)

Mr. Bennett, speaking of the Zoological Society's Menagerie, says:—"Of all the gallinaceous birds in the collection, the most interesting are those which hold out to us a prospect of supplying our farm-yards with new breeds of poultry of a superior kind. Such are especially the Curassows. In many parts of South America these birds have long been reclaimed; and it is really surprising, considering the extreme familiarity of their manners and the facility with which they appear to pass from a state of nature to the tameness of domestic fowls, that they have not yet been introduced into the poultry-yards of Europe. That with proper treatment they would speedily become habituated to the climate we have no reason to doubt; on the contrary, numerous examples have shown that they thrive well even in its northern parts; and Temminck informs us that they have once at least been thoroughly acclimated in Holland, where they were as prolific in their domesticated state as any of our common poultry. The establishment however in which this had been effected was broken up by the civil commotions which followed in the train of the French revolution, and all the pains which had been bestowed upon the education of these birds were lost to the world by their sudden and complete dispersion. The task which had at that time been in some measure accomplished still remains to be performed; and it may not be too much to expect that the Zoological Society may be successful in perfecting what was then so well begun, and in naturalising the Curassow as completely as our ancestors have done the equally exotic and in their wild state much less familiar breeds of the turkey, the Guinea-fowl, and the peacock. Their introduction would certainly be most desirable, not merely on account of their size and beauty, but also for the whiteness and excellence of their flesh, which is said by those who have eaten of it to surpass that of the Guinea-fowl or of the pheasant in the delicacy of its flavour." ('Gardens and Menagerie,' &c., vol. ii.)

Lieutenant Maw, who appears to have shot a Red-Knobbed Curassow on his passage from the Pacific to the Atlantic down the river Marañon, says that the native Peruvian name for the bird is Peury.

Penelope.—Bill moderate, naked at the base, entire, convex above, wider than it is high, bent at the point; lore and base of the bill naked. Under the throat a naked skin which is capable of being inflated or swollen. Nostrils pierced in the cere towards the middle of the bill, half closed. Foot (tarsus) slender, longer than the intermediate toe; nails somewhat curved, strong, compressed, and pointed. Fifth and sixth quill longest. Tail-feathers 12.

P. cristata (Gmelin), the Guan. Length about 30 inches, the tail being 13 or 14 inches. Upper parts dusky black or bronze, glossed with green, changing to olive in certain lights. A black stripe passes from the under part of the bill backwards, and surrounds the ear. Fore part of neck and breast spotted with whitish, each of the feathers being bordered by white; belly and legs, lower part of the back, and under tail-coverts, reddish. Cheeks naked and violet-purplish. Iris reddish brown. Bill blackish. Feathers of the back of the head long, forming a thick tufted crest, which the bird can raise or depress at pleasure. Naked part of the throat scarlet, with a contractile and extensile fold of depending skin. Mr. Bennett observes that this fold retains its elasticity after death. The female differs from the male principally in having her plumage, especially her under parts, more decidedly tinged with red.

Guan (*Penelope cristata*).

Mr. Yarrell states that the trachea of the Guan is uniform in size and substance throughout its whole length. After descending by the neck in the usual way, it is extended, and passes downwards under the skin, but over the outer surface of the pectoral muscle on the right side, to the extent of two inches beyond the angle formed by the junction of the two portions of the os furcatorium. The tube of the trachea is then reflected, and, ascending to the cavity of the thorax, again turns to be carried to the lungs as in other birds, and is provided with one pair of true muscles of voice, which have the usual origin and insertion. The loop or fold of the tube formed on the surface of the pectoral muscle is imbedded in cellular tissue, and further retained in its place by a strong ligament, which, firmly adhering to the loop, passes backwards to be first attached to the posterior angle of the sternum; and afterwards dividing once, and passing still farther backwards, the two slips are inserted on the two elongated pubic points of the pelvis. This structure in the Guan, Mr. Yarrell observes, has been noticed and figured by M. Temminck in his 'Histoire des Pigeons et Gallinacés.'

Mr. Bennett remarks that the manners of the Guan have little to distinguish them from those of the Curassows. Although to all appearance equally capable of domestication, they have not yet been introduced into Europe in equal numbers with the Curassows, nor has the same success attended the attempts to propagate them in this quarter of the globe. "We are told however," continues Mr. Bennett, "by M. Temminck, that the proprietor of a menagerie in the neighbourhood of Utrecht had bred them for several years; and there can be little doubt that with proper care and attention these birds might be added to the stock of our domesticated fowls. They are spoken of as furnishing an excellent dish for the table. In a wild state they inhabit Guyana and Brazil, and perhaps extend still farther to the north. Their food consists principally of seeds and fruits, which they search for and eat upon the ground; but the greater part of their existence is passed upon the trees, on the tops of which they perch, and in which they build their nests. They are often found in large bands, but generally pair together with the strictest constancy. The females lay from two to five eggs. Their flight, like that of most gallinaceous birds, in consequence of the shortness of their wings, is low and heavy; and in the performance of this action they derive much assistance from their tail, the feathers of which may be expanded in the shape of a fan. All the birds of this genus appear to be known in Brazil by the name of Jacu, pronounced Yacou, derived, according to Marcgrave, from their note. This, as might be expected from the conformation of their trachea, is extremely loud, insomuch that when a considerable number are collected near the same spot, the very woods, to use the expression of the scientific traveller just quoted, re-echo with their clamorous cries." The same author observes that M. Spix added very considerably to the difficulties that previously existed in distinguishing the species of this interesting group by the publication, in his 'Brazilian Birds,' of a series of figures representing apparently very slight modifications of the common form, but to each of which he has prefixed a peculiar specific name. Mr. Bennett expresses his belief that most of these will be found on further examination to be referrible to the present species, which, from its long domestication in the poultry-yards of South America, must necessarily be subject to very extensive variations. ('Gardens and Menagerie of the Zoological Society,' vol. ii.)

M. Lesson, on the authority of M. Goudot, mentions a species, *Penelope Aburri*, Goud., 2 feet 3 inches (French) long, the tail being 10 inches. M. Goudot states that this species seems peculiar to the mountains of New Granada, inhabiting temperate and cold districts; it is, he says, unknown in the great warm valleys and by the rivers. In the environs of the city of Muzo, celebrated for its mine of emeralds, this bird, he states, is known under the name of Pavo-ò-Guali. The inhabitants of the neighbourhood of Bogota and of the valley of Cauca designate it by the term Pava Burri, or Aburri Aburrida, which when slowly pronounced well expresses its cry. The male does not differ from the female; and those which M. Goudot opened had two cæcums analogous to *Penelope Parakona* and *Pavita* (*superciliaris?*). The trachea descended without any fold to the lungs. There was no gravel in the gizzard, the walls of which were thin, and nearly entirely covered by the proper muscles. M. Goudot states that the species lives solitary, perches upon high trees, flies but little, and suffers the hunter to approach easily within shot. It is never seen on the ground. The berries of trees compose its food. Its nest is formed in a mass of dry leaves, disposed between the forks of trees. The eggs are three in number, white, and 1 inch 8 lines in diameter. These birds, adds M. Goudot, are very common in the mountains of Quindiu, between Ilague and Carthagena. Their notes are the last that are heard on the approach of night, and the first that announce the dawn of day.

Ortalida.—Its characters are the same as those of *Penelope*, excepting that the head is completely feathered, and that there is no nakedness about the throat or round the eyes.

O. Motmot, *Phasianus Motmot*, Gmel., *Phasianus Parraqua*, Lath. Colour red-brown, bronzed above. Tail moderate. It inhabits Guyana.

Ortalida Motmot.

M. Goudot describes a new species from Santa-Fé de Bogota, which M. Lesson names *Ortalida Goudotii.* The bird it appears is found in the same places with the *Penelope Aburri*. Total length 23 inches, of which the tail is 9 inches. Feet red; tarsus 2 inches 5 lines; middle toe 2 inches 4 lines, the claw being 5½ lines (French). The bill is blackish, brown at its point; the upper mandible 1 inch 5 lines; cere and naked membrane round the eyes blue. All the upper plumage brown, with deep green reflections, or rather of a very deep greenish. Feathers of the throat gray. Bottom of the neck, belly, and abdomen, as well as the thighs, covered with ruddy. No crest nor nakedness about the throat. No fold of the trachea in either sex. It is found in the mountains of Quindiu.

M. Lesson observes that this bird approaches nearly to the last, but is clearly distinguishable from it, especially by the trachea, which does not descend upon the abdomen.

Opisthocomus, Hoffm. (Hoazin, Buff.; *Orthocorys*, Vieill.).—Bill thick, robust, short, convex, bent at the point, which is suddenly compressed, furnished with diverging bristles at the base, which is dilated laterally; lower mandible strong, terminated in an angle; edges dentelated towards the origin. Nostrils mesial on the surface of the bill, pierced (de part en part), covered above by a membrane. Feet robust and muscular; tarsus shorter than the middle toe, the lateral toes long, equal, entirely divided; sole broad; toes bordered with rudiments of membranes. Wings moderate, the first quill very short, the four following graduated, and the sixth the longest. Tail-feathers ten.

O. cristatus. This species, which appears to be the only one belonging to the genus, is the Hoatzin and Hoactzin of Hernandez; who describes it as an inhabitant of warm districts, where it was seen sitting on trees by the sides of rivers, and as having received its name from a supposed similarity of the shrieking cry of the bird to the intonation of the word 'hoatzin.' Hernandez relates some strange stories of cures effected by its bones and by a suffitus of its feathers; but says that the bird is deemed inauspicious by the natives. Sonnini states that it is known in Guyana by the name of Sasa.

Hoazin (*Opisthocomus cristatus*).

The Hoazins are said to live in pairs or in small troops, consisting of from six to eight individuals, in the flooded savannahs, which they prefer, and where they seek for their food the leaves of the *Arum arborescens*. Their flesh is not considered good, having a strong smell of Castoreum about it. These birds are by no means timorous. In stature and gait they resemble the peacock.

Megapodius.—Bill slender, straight, as wide as it is high, and flattened above at the base: upper mandible longer than the lower, slightly curved at its extremity; lower mandible straight, the point hidden by the edges of the upper mandible. Nostrils suboval, open, placed nearer to the point than to the base of the bill; nasal fossæ long, covered by a membrane furnished with small feathers. Space round the eye naked, head and neck well feathered. Feet large and strong, placed far backwards; tarsus large and long, and covered with large scales, compressed posteriorly; four very elongated toes, the three anterior ones nearly equal, united at their bases by a small membrane, which is more apparent between the inner and middle toe than between it and the outer one; posterior toe horizontal, touching the ground throughout its length; claws very long, very strong, flattened above, very little curved, triangular, obtuse at the point, nearly like those of *Menura*. Wings moderate, concave, rounded; third and fourth quills the longest. Tail small, wedge-shaped, scarcely exceeding the wings in length, and formed of twelve feathers. (Quoy and Gaimard, with slight alteration.)

M. Duperreyii. In size hardly so large as a partridge. Tarsi less elevated than they are in *M. Freycinetii* and *M. rubripes*. The bird is moreover altogether better proportioned. Total length, from the extremity of the bill to that of the wings, which are longer than the tail, rather less than a foot (French). Tarsi strong, covered with scales, and 20 lines in length; middle toe, including the claw, 17 lines; hind toe 14 lines; posterior claw 7 lines. Bill slightly swollen towards its extremity, yellow, 8 lines in length. Nostrils suboval, covered with a membrane clothed with very small rudimentary feathers. Space round the eyes naked, but less than in the other two species. Neck well clothed with feathers. Iris reddish. A very thick crest covers the head; the feathers which compose it are raised (se redressent) towards the occiput. The wings are concave, an inch longer than the tail, and terminated in a point: the fifth quill the longest. Tail suboval, pointed, very short, composed of 10 small feathers. Legs grayish, and feathered down to the tarsi; the claws slightly curved, pointed at the end, flat below, and of a brown colour. (Lesson.)

Mangoipe (*Magapodius Duperreyii*).

"The tuft," says M. Lesson, "of our *M. Duperreyii* is of a brown-yellow; the neck, the throat, the belly, and the lateral parts, are of a gray-slate colour. The feathers of the back and the wing-coverts large, and of a ruddy yellowish-brown. Rump, upper part of the tail, and vent-feathers, ochreous red. Quills yellow without, brown within, the shafts being ruddy brown.

"The middle toe is united to the inner one by a membranous border, which is wanting between the middle toe and the external one.

"In comparing our *Megapodius* with the *Menura* of New Holland, we cannot fail to perceive that it connects the last-mentioned genus with the gallinaceous birds, by forming a very natural passage. In fact, if we examine the position of the nostrils, the general form of the bill and legs, and the nakedness round the eyes—the membrane which unites the two external toes, but which is wanting between the middle toe and the inner one (an arrangement which is reversed in *Megapodius*)—the same length of the toes, the analogy in the form of the claws, the greater length of the posterior one, the concavity and the smallness of the wings—all these characters, in fine, coincide to confirm this passage, if we except the extraordinary grandeur and luxuriant form of the tail of *Menura*, a form without analogy among the other birds. *Megapodius* would thus belong to a small natural group, the *Lyriferi* of Vieillot (27th family); the name of which, in consequence of its having become improper, would have to be changed.

"The *M. Duperreyii*, the Mangoipe of the Papuans, inhabits the umbrageous forests of New Guinea, in the neighbourhood of the harbour of Doréry. The bird is timid, runs very fast among the bushes, like a partridge in standing corn, and utters a feeble cluck (un petit gloussement)."

M. Lesson states that he only observed *M. Freycinetii* in the Island of Waigiou, and that the attempt to preserve it alive in cages was vain, for the birds soon died. Their flesh, he says, is black, very hard, and not very agreeable as food, although possessing a fumet which the cooking developes. The Papuans brought them on board the Coquille daily, and called them (those of the harbour of Offack at least) Manesaqué.

Both Pigafetta and Gemelli Carreri speak of the Tavon (*Megapodius*), and it would seem that this, the *Megapodius* of the Philippines, leaves its eggs to the fostering heat of the sun. The habits of the *Megapodii* of New Guinea and the neighbouring islands are, according to M. Lesson, entirely unknown.

Alecthelia.—The characters of the genus *Megapodius*, observes M. Lesson, established by Messrs. Quoy and Gaimard in the Zoology of the voyage round the world performed by the Uranie, are in great measure applicable to the sub-genus *Alecthelia*, formed by M. Lessou for the position of a bird which differs from the true *Megapodii*, or Tavons, by many distinctive characters.

Bill short, compressed, pointed: the upper mandible prolonged, the lower mandible a little swollen and very short; nostrils at the base of the bill separated by a straight ridge; head and forehead abundantly covered with feathers down to the nostrils; space round the eyes furnished with short and close-set feathers; inner toe rather the shortest; membrane which unites the middle toe to the inner one almost absent; no tail; all the feathers of the body, except those of the wings, composed of loose barbs, very finely ciliated on each of the shafts.

A. Urvillii, Lesson. It is the only species known. Its total length from the extremity of the bill to that of the wings is 5 inches 4 lines. Tarsi 14 lines; middle toe 10, hind toe 8, claws 5, bill 6 lines (French). The bird is covered with loose and scanty feathers, but has upon the occiput a thick bunch of feathers. The general tint is brown, fuliginous, deepest above; belly and throat brown, slightly tinged with ruddy colour; throat ash-coloured; wings concave, rounded, the feathers entirely brown, the second, third, and fourth being equal: the upper part is brown sprinkled with zigzag or irregular lines, not well defined, of ruddy yellow. Place of the tail-feathers supplied by very loose plumes, composed of very fine barbs, bristled with very slender approximated barbules, presenting much analogy with those of the Cassowary (No. 6, pl. 67, 'Atlas de Peron'), and which, implanted in the rump in the same manner, form a feathery tuft as in the Cassowary; all the feathers of this bird, except those of the wings, are composed of multiple stems, very slender and soft, furnished with equal and very fine barbules which may be called multirachid. The bill is grayish, and so are the feet; the inner toe is a little more united to the middle one than to the external one; the claws are slightly curved, sharp, convex above, concave below, and of a brown colour; the iris is reddish.

Alecthelia Urvillii.

This species, which comes from the Isle of Guebé, placed immediately under the equator, is, no doubt, proper to the neighbouring lands such as the great and beautiful Isle of Halamiva or Golilo, so little known and so little studied by naturalists. (Lesson.)

CRAG, the uppermost of the distinctly Tertiary Strata of England —using this term in a sense which is perhaps gradually passing away, to be replaced by the larger meaning of Cainozoic, suggested in this work. The Crag of Norfolk and Suffolk is partly a calcareous mass rich in delicate corals; partly a subcalcareous sand rich in shells; and partly a rudely aggregated deposit of sand, shells, pebbles, and bones. To these divisions, whose origin is due to different local conditions, and successive times, Mr. Charlesworth has assigned the titles of Coralline Crag, Red Crag, aud Mammaliferous Crag. The position of these beds will be best seen from the following table of the classification of the Tertiary Rocks from Professor Ansted's 'Elemeutary Geology.'

Newer Tertiary, or Pliocene Series:—
1. Upper Gravel and Sand.
2. Till.
3. *Mammaliferous Crag.*
4. Fresh-Water Sand and Gravel.
5. *Red Crag.*

Middle Tertiary, or Miocene Series:—
6. *Coralline Crag.*

Lower Tertiary, or Eoceue Series:—
7. Fluvio-Marine Beds, &c.

For a further account of the Crag Formation, and its relation to the other members of the Tertiary Series, see Tertiary Strata.

CRAKE. [Rallidæ.]

CRAMBE, a genus of Plants belonging to the natural order *Cruciferæ*. It belongs to the sub-order *Lomentaceæ* and the tribe *Raphaneæ*. It has a 2-jointed silicle, upper joint globose, with 1 seed pendent from a long curved seed-stalk springing from the bottom of the cell; lower joint barren, stalk-like.

C. maritima, the Sea-Kail, or Sea-Kale, is a glaucous spreading plant, with broad-toothed sinuated leaves, and dense corymbs of large white flowers, found occasionally on the sea-coast of England, and now commonly cultivated in gardens for the sake of its delicate tender shoots. Naturally the flavour of the plant is strong, cabbage-like, and highly disagreeable, but in the state in which it is sent to the kitchen, it is merely a colourless mass of delicate fleshy vegetable tissue, with little or no flavour. This arises from the shoots that are to be cooked being grown in darkness, and with a little more speed than usual. For this purpose a garden-pot is inverted over the crown of an old sea-kail stock, in the winter before the leaves sprout. Over the pot is thrown a little litter, or some decaying leaves, or some old tan, so as to increase the temperature of the earth, and to exclude light; after a week or two the pot is examined from time to time, and when sprouts five or six inches long have been produced, they are cut off, and are fit for table.

Sea-Kail loves a light sandy soil, well drained in winter and richly manured. It will continue to bear cutting for twenty years together without suffering much; and is one of the most simple and useful of all culinary plants for a small garden. It is generally grown in rows eighteen inches or two feet apart.

CRAMBUS, a genus of Moths (*Lepidoptera nocturna*) of the family *Tineidæ* (Stephens). The type of this genus is the *Phalæna Pascuella* of Linnæus.

In crossing dry meadows during the summer time, we observe numerous little moths fly from the grass at every step we take; they soon settle again, and are then not easily detected, owing to their mode of folding their wings, which when shut almost inclose their slender bodies, and partly surround the blade of grass on which they rest; their form is then long and narrow, pointed at the head, and somewhat truncated at the opposite extremity. Their colouring is often brown and white, disposed on the upper wings principally in longitudinal lines. Very frequently however we find them adorned with beautiful metallic colours, generally of silvery or golden hues. Such are the insects which constitute the genus *Crambus*, and of which we possess about 40 species in this country. The characters of this genus are:—Proboscis distinct; wings convoluted round the body when at rest; superior wings narrow; palpi long, the inferior the longer; head furnished with short closely-applied scales.

When the wings are expanded, these moths commonly measure about an inch in width; they are called in England the Veneers, and sometimes Grass-Moths.

CRANBERRY. [Oxycoccus.]

CRANE-FLY. [Tipulidæ.]

CRANES. [Gruidæ.]

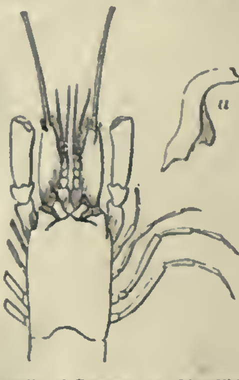
CRANE'S-BILL. [Geranium.]

CRANGONIDÆ, a family of *Crustacea* belonging to the division *Decapoda Macroura*. The type of this family is the Common Shrimp (*Crangon vulgaris*), and no other genera are included in it. It has the following characters:—

Internal antennæ inserted on the same line as the external antennæ; first pair of feet terminated by a subcheliform hand. Although there are a large number of *Crustacea* which are vulgarly called Shrimps which resemble in general form the Common Shrimp, the *Crangonidæ* differ too much from all these to be comprised in the natural tribes formed by them. It corresponds to the genus *Crangon* of Fabricius, which, in the opinion of M. Milne-Edwards, has been unnecessarily subdivided by Dr. Leach and M. Risso into the Crangons, properly so called, Egeons, and *Pontophili*.

Crangon comprises those shrimps whose anterior feet are terminated by a monodactylous and subcheliform hand.

Carapace much more depressed than in the other shrimps, and presenting anteriorly only the rudiment of a rostrum. Eyes short, large, and free. Antennæ inserted nearly on the same transversal line; the first pair dilated at their base, at the external side of which is a rather large scale; their peduncle is short, and they are terminated by two multi-articulate filaments. The external antennæ are inserted outwardly and a little below the preceding, and they offer nothing remarkable. The mandibles are slender, and without any palp. The external jaw-feet, which are pediform and of moderate length, terminate by a flattened and obtuse point; within, they carry a short palp, terminated by a small flagriform appendage directed inwards. The sternum is very wide backwards. The first pair of feet are strong, and terminate in a flattened hand, on the anterior edge of which a moveable claw is bent back: the internal angle of this hand, which corresponds to the point of the claw, is armed with a tooth representing an immoveable rudimentary finger. The two succeeding pairs of feet are extremely slender; the second terminate generally in a very small didactylous claw; and the third are monodactylous, like those of the fourth and fifth pairs; but these four posterior feet are much stronger. The abdomen is very large, but presents nothing remarkable in its conformation. The branchiæ are only seven in number on each side of the thorax. (Milne-Edwards.)



Details of *Crangon*. *a*, Mandible.

The genus is divided by M. Milne-Edwards into the following sections:—

1. Species having the second pair of feet nearly as long as the third pair.

In this section are comprised *C. vulgaris*, *C. fasciatus*, and *C. Boreas*.

2. Species with the second pair of feet much longer than the third. Example, *C. septemcarinatus*.

C. vulgaris, the Common Shrimp. Carapace and abdomen almost entirely smooth, with the exception of one small median spine on the stomachal region, and one lateral above each branchial region. Terminal filaments of the internal antennæ more than twice as long as their peduncle. Lamellar appendage of the external antennæ large and elongated (about twice as long as the peduncle of the internal antennæ). Last joint of the external jaw-feet long and narrow. Two last pairs of feet of moderate size. A strong spine inserted on the sternum between the second pair of feet, and directed forwards. Abdomen smooth, and without any keel. Median blade of the caudal fin pointed, and without a furrow above. Length rather more than two inches. Colour greenish-gray, dotted with brown.

Common Shrimp (*Crangon vulgaris*). *a*, anterior foot or claw.

It is common on the coasts of England and France.

It is the Crevette of the French, and Shrimp of our markets, and is one of the most delicious (Pennant thinks the most delicious) of the macrurous crustaceans.

The shoals of these creatures which frequent our coast give employment to a great number of persons, who are engaged in catching them. They are abundant at the mouth of the Thames, from whence the London market is principally supplied. They are caught by a large open net, which is attached to a long stick and pushed through the water. They are most plentiful on sandy shores. They are used also for bait.

C. fasciatus, the Banded Shrimp, is found in the Mediterranean. It has also been taken in England at Salcombe Bay.

C. spinosus, the Spiny Shrimp. It is the *Pontophilus spinosus* of Leach; *Egeon loricatus* of Guerin. This shrimp has been taken in several places on the south coast of England.

C. sculptus is a British species, described by Professor Bell in his 'History of the British Stalk-Eyed Crustacea.' It was taken at Weymouth by Mr. Bowerbank.

C. trispinosus and *C. bispinosus* are also British species, and have been taken on the coast of Hastings.

CRANIA. [BRACHIOPODA.]

CRASSAMENTUM. [BLOOD.]

CRASSATELLA. [CONCHACEA.]

CRASSINA. [VENERIDÆ.]

CRASSULA, a genus of Plants, the type of the natural order *Crassulaceæ*. It has a 5-parted calyx, much shorter than the corolla; sepals flattish; the petals 5, stellate, spreading, distinct; the stamens 5, filaments awl-shaped; scales 5, ovate, short; carpels 5, many-seeded. The species are very numerous. They are succulent herbs or shrubs, and are mostly natives of the Cape of Good Hope. Their leaves are opposite and entire, or nearly so. The flowers are mostly white, rarely rose-coloured. Upwards of fifty species have been described; and many of them, on account of their grotesque appearance, are cultivated in our gardens. They are greenhouse plants. One species, *C. tetragona*, is used at the Cape of Good Hope as a remedy in dysentery. Any medicinal properties they possess is probably owing to the presence of tannin.

CRASSULA'CEÆ, *House-Leeks*, a natural order of Polypetalous Exogenous Plants. It consists of succulent plants, with herbaceous or shrubby, and annual or perennial roots, growing in hot dry exposed places in the more temperate parts of the Old World chiefly. On the sun-scorched cliffs and volcanic soil of the Canaries, and on the dry sterile plains of the Cape of Good Hope, they are most abundant. Their flowers are arranged in panicles, spikes, cymes, and corymbs; each has a calyx of several divisions, alternating with which is the like number of petals, alternating with which is the like number of stamens, or twice as many, alternating with which are as many

Crassulaceæ.

A, a portion of a branch of *Sempervivum villosum*; 1, a calyx of *S. montanum*; 2, a part of the petals and stamens laid open, and adhering by the tube of the calyx; 3, a calyx with the ovaries projecting—the hypogynous scales are seen at the base of some of these; 4, a ripe follicle; 5, a section of a seed showing the embryo in the albumen.

distinct carpels as there are segments of the calyx. The stamens arise from the tube of the calyx; there is usually a hypogynous gland at the base of each carpel; the carpels are often of the same colour as the petals; and sometimes, in monstrous cases, the anthers bear ovules as well as the ovaries. The fruit consists of a number of distinct follicles, each containing numerous minute seeds; the embryo lies in the axis of fleshy albumen. The affinities of this order, according to Dr. Lindley, are with *Sauvagesiaceæ*, *Caryophyllaceæ*, *Saxifragaceæ*, and *Turneraceæ*.

Many species of *Crassula*, *Rochea*, *Sempervivum*, *Sedum*, &c., are cultivated for the beauty of their flowers; the various annual Tillæas, &c., are obscure weeds; house-leeks (different sorts of *Sempervivum*) are grown for their refrigerant qualities; and the leaves of *Sempervivum arboreum* possess powerful tanning qualities. This order contains 22 genera and 450 species. [SEDUM; SEMPERVIVUM; COTYLEDON; ECHEVERIA; TILLÆA; ROCHEA; RHODIOLA; UMBILICUS; BRYOPHYLLUM.]

All the hardy species may be grown on old walls, roofs, rock-work, or other places thoroughly drained of moisture; the greenhouse kinds require what is called a dry-stove treatment—that is, they must be potted in a mixture of lime, rubbish, broken pots, and earth; in summer they are freely exposed to the weather in sunny situations without protection, and in winter they are kept moderately cool, and nearly without water.

CRATÆ'GUS, a genus of Plants belonging to the natural order *Rosaceæ* and the sub-order *Pomeæ*. This genus is very nearly allied to the Apple (*Pyrus*), from which it differs in the fruit containing a variable number of stones, as the Medlar does; from the Medlar it is known by its fruit being closed, not spread open, at the apex.

The species inhabit woods and hedges throughout the northern hemisphere, from Barbary and Palestine to about 60° N. lat. in the east, and from Mexico to a similar latitude in the west. South of these limits they do not occur in a wild state. The flowers appear in the greatest profusion, usually in terminal cymes, in the early months of the year, and are succeeded by small round fruits, coloured yellow, red, purple, or black. Most of them are merely haws, and fit only for the food of birds; a few are larger and more fleshy, but none of them have been found worth cultivating for the fruit, except the Azarole (*Cratægus Azarolus*), which is eaten in Italy, and the Aronia, which is sold in the markets of Montpellier under the name of Pommettes à Deux Closes.

Between sixty and seventy well-marked species and varieties are known in the gardens of this country. Into extensive collections they are all worth introduction, except *C. parvifolia* and those immediately allied to it; and for the ornament of park-scenery there is probably no genus of flowering trees at all to be compared with *Cratægus* for variety, fragrance, and beauty. Our limits prevent our noticing all these at length; we therefore confine ourselves to a brief indication of those which are most valuable for ornamental purposes.

C. oxyacantha, the Hawthorn, White Thorn, or May. The leaves are obovate, 3-4-lobed, cut and serrate, cuneate at the base; the flowers corymbose; calyx not glandular; styles 1-3. The branches are spinose. This plant is one of the most common in the British Flora, being used throughout the kingdom for forming quickset hedges. Babington mentions two varieties, expressing an opinion that they are not improbably distinct species—*C. oxyacantha* (Linnæus and Jacquin), with the peduncles and calyx glabrous, and *C. monogyna* (Jacquin), with the peduncles and calyx villose. The latter is the more common form.

The Hawthorn not only grows in the form of a shrub or bush in our hedges, but is not unfrequently seen in the form of a tree. It is of slow growth, and many individuals have attained celebrity for their antiquity. There are several in Bushy Park said to be above two centuries old. The wood of the Hawthorn is hard, takes a fine polish, and is used by cabinet-makers.

Under the name of Hawthorns may be comprehended all the numerous sorts which are either varieties of *Cratægus oxyacantha* or nearly related to it. They have all deeply-lobed rather shining leaves, so little hairy that their bright green colour is not deadened, small fragrant flowers, and small shining haws. They are distinguished for the graceful manner in which they generally grow in rich soil and unharmed by the pruning-knife. Thirty feet is not an unusual height for very fine specimens, and when of that size their appearance is exceedingly graceful and picturesque. *C. oxyacantha* itself produces varieties with double flowers, bright crimson flowers, yellow fruit, black fruit, and fruit downy when young; the latter is called *C. oxyacantha eriocarpa*, and is one of the most beautiful of the genus.

Very nearly allied to these are the Oriental Thorns, species which have their deeply-cut leaves covered so closely with hairs as to have a dull gray or hoary aspect, large fragrant flowers, and large succulent rather angular fruit. These are less graceful in their manner of growth than the true Hawthorns, some of them, especially *C. tanacetifolia* and *C. odoratissima*, having a round formal head; but their flowers are even more fragrant than the May-bush, and their fruit renders them striking objects in the autumn. The Azarole is one of them; but it does not fruit or flower readily, and is the least worth having of the group. We should recommend *C. odoratissima*, with its red fruit, *C. tanacetifolia* with its yellow fruit, *C. orientalis* with purple fruit, and *C. Aronia* with its light orange-coloured fruit.

The American Thorns are species with leaves but little lobed, usually broad, shining, and toothed unequally, often having exceedingly long spines, and having fruit generally of an intermediate size

They are not quite so handsome as the species of the two former groups; but the following, nevertheless, have sufficiently ornamental features, namely—*C. Crusgalli*, or the Cockspur Thorn, with very long strong spines and shining deep green leaves; of this we have a broad-leaved variety called *C. splendens*, and a narrow-leaved variety called *C. salicifolia*; *C. prunifolia*, *C. ovalifolia*, and *C. Douglasii*, with dark handsome leaves; *C. punctata*, with large yellow or red haws; *C. cordata*, with brilliant scarlet fruit; and *C. microcarpa*, with very small beautiful vermilion fruit and graceful pendulous shoots.

The Small-Leaved Thorns are all North American: they form small straggling bushes, and are not worth cultivation.

Finally, the Evergreen Thorns consist of *C. Mexicana* and *C. pyracantha*. The former is a small tree with lance-shaped bright green leaves, and large round yellow fruit; it is probably too tender for hardy cultivation north of London. The latter, an inhabitant of rocks and wild places in the south of Europe and the Caucasus, has been long cultivated in this country for the sake of its flame-coloured berries and evergreen leaves.

All these plants may be budded or grafted upon the Common Hawthorn, so that persons whose means do not allow them to purchase the plants may nevertheless ornament their gardens with them by providing hawthorn stocks, upon which they may work them themselves; or a very small garden might exhibit a good many sorts, if each of the groups here pointed out were intermixed upon the same plant. This might be easily effected by a skilful budder. It would not however do to intermix the different groups upon the same plant, because the species would not harmonise, and consequently a bad appearance would be the result.

(London, *Arboretum et Fruticetum Britannicum*; *Botanical Register*, vols. xxi. and xxii.)

CRATÆVA, a genus of Plants belonging to the natural order *Capparidaceæ*. It has 4 sepals; 4 unguiculate petals larger than the calyx, and not closing over the stamens during æstivation; 8-28 stamens; the torus elongated or hemispherical; the berry stalked, between ovate and globose, pulpy within; a thin pericarp. The species are unarmed shrubs or trees with trifoliate leaves and terminal cymes or racemes of large flowers.

C. gynandra, Garlic Pear, has 20-24 stamens inserted on the cylindrical receptacle, longer than the petals; the berry ovate; the leaflets ovate, acute; the petals lanceolate. It is a native of bushy places and thickets near the sea-side in Jamaica. The whole plant has a nauseous smell and a burning taste. The bark of the root is said to blister like cantharides.

C. Tapia, the Tapia, or Common Garlic-Pear, has 8-16 stamens, declinate, about three times as long as the petals; the stipe of the ovary as long as the stamens; the stigma sessile, capitate; the fruit globose. This plant is a tree about 20 feet high. Its fruit is the size of a small orange. It is brought both from the West India Islands and from South America. The fruit has the smell of garlic, and communicates its odour to animals that feed on it. The bark is bitter and tonic, and has been employed in the cure of intermittent fevers.

C. Marmelos, the Bilva, or Mahura, is a small tree bearing a large spheroidal berry with a hard shell, and 10-15 cells which contain, besides the seeds, a large quantity of a tenacious transparent gluten, which on drying becomes very hard, but continues transparent; when fresh it may be drawn out, before it breaks, into threads of one or two yards in length, and so fine as scarcely to be perceptible to the naked eye. This plant is now however transferred to the family *Aurantiaceæ*, under the generic name *Ægle*. It is the *Feronia pellucida* of some authors. It is found in all parts of the East Indies. The fruit is nutritious and aperient, and very delicious to the taste. It is recommended by European physicians in the East as a valuable remedy in habitual costiveness, and it is said never to fail in producing its aperient effects. The root, bark, and leaves are also used in fevers by the Malabar physicians.

(Lindley, *Flora Medica*; Don, *Dichlamydeous Plants*.)

CRAW-FISH. [ASTACUS.]

CRAX. [CRACIDÆ.]

CRAY-FISH. [ASTACUS.]

CREAM-FRUIT, a kind of eatable Fruit found at Sierra Leone, and said to be produced by some Apocynaceous Plant.

CREEPERS. [CERTHIADÆ.]

CRENATULA. [MALLEACEA.]

CRENELLA. [MYTILIDÆ.]

CRENILA'BRUS (Cuvier), a genus of Fishes belonging to the section *Acanthopterygii* and family *Labridæ*. The species of this genus have all the general characters of the true *Labri*, or Wrasses, but are distinguished by their having the margin of the pre-operculum denticulated: the cheeks and operculum are scaly.

C. melops (*Labrus melops*, Linnæus), *C. tinca* of others, the Gilt-Head, Connor, Golden Maid. This fish is found on various parts of the coast; it is about six inches in length, and the depth is nearly one-third of the length. The general colour of the body is obscure red and green; these colours are arranged in longitudinal stripes on the upper parts, and beneath the lateral line the red is disposed in spots. The Gilt-Head mostly frequents deep water, where the bottom is rocky; its food is chiefly *Crustacea*.

C. Norvegicus (Cuv. et Val.), *C. Cornubicus* (Risso), the Goldfinny or Goldsinny, and Corkwing, somewhat resembles the last, but may always be distinguished by a black spot on each side near the base of the tail, and situated on the lateral line; its general colour is yellowish green, darkest on the back; the sides are usually adorned with longitudinal lines of a deeper hue. Length about three or four inches.

C. gibbus, the Gibbous Wrasse, may be readily distinguished from either of the known British species of this genus by its comparatively shorter and more elevated form. The depth of the body is considerably more than one-third of the length: the colours are chiefly orange and blue; the gill-covers and sides of the body are spotted, and the back is striped. The ventral fins are green, the pectorals are yellow, with transverse red stripes at their base.

Pennant obtained a specimen of this fish off the coast of Anglesey; and this is we believe the only instance on record of its capture off the British coasts.

C. luscus (Couch), *Acantholabrus Couchii* (Cuv. et Val.), the Scale-Rayed Wrasse, has been caught by Mr. Couch off the coast of Cornwall: the specimen was 22 inches in length. The tail is round, and consists of 15 rays; "between each ray of the dorsal, anal, and caudal fins, is a process formed of firm, elongated, imbricated scales. Colour, a uniform light brown, lighter on the belly; upper eye-lid black; at the upper edge of the base of the caudal fin is a dark brown spot. Pectorals yellow: all the other fins bordered with yellow."

C. multidentatus (Thompson), *Turdus minor* (Ray), *Labrus pusillus* (Jenyns), the Corkling, Ball's Wrasse. This fish was originally taken on the British coast by Professor Henslow at Weymouth. It has since been taken in Cornwall and Ireland. It is about four inches in length. Mr. Jenyns says, "It is quite distinct from any of those described by other authors. Though belonging to the present section (*Labrus*) which it is convenient to retain, it would seem to form the transition to the *Crenilabri*, to which its near affinity is indicated by the rudimentary denticulations on the margin of the pre-opercle."

C. rupestris, Jago's Goldsinny (Selby). It has been referred by various writers to the genera *Sciæna*, *Labrus Perca*, and *Lutjanus*. Several specimens of this fish have been taken in Great Britain. It is found occasionally in the Baltic, in Sweden, Denmark, and Norway. Its prevailing colour is orange, the free edge of each scale being of a light golden-yellow colour; the colour is darkest over the three or four lines of scales along the highest part of the back, and lightest on the lower part of the sides and belly; the body is indistinctly marked with five transverse bands. In northern localities it is tinged with green.

C. microstoma, the Small-Mouthed Wrasse, or Rock-Cook (Thompson). It is the *Acantholabrus exoletus* (Cuv. and Val.), the *Labrus exoletus* of other authors. This fish is occasionally caught in Cornwall, and has been taken at Antrim in Ireland. It is immediately known amongst its congeners by its very small mouth. It is found on the coasts of Sweden, Denmark and Norway. [LABRIDÆ.]

CREPIDO'PTERIS, a genus of Fossil Ferns, which Presl substitutes for *Pecopteris* of Brongniart, in the case of two species, one from Stuttgardt, the other from Newcastle.

CREPIDULA. [CALYPTRÆIDÆ.]

CREPIS, a genus of Plants belonging to the natural order *Compositæ*, the division *Cichoraceæ*, and section *Lactuceæ*. It has many-flowered heads; a double involucre, the inner of one row, the outer of short lax scales; the fruit terete, narrowed upwards or obscurely beaked. Most of the species of this genus are common weeds in the hedges of Europe. Five of the species are found in Great Britain. The most common is the *C. virens*, which has the outer involucral scales adpressed, linear, the inner ones glabrous within: the leaves lanceolate, remotely dentate, runcinate, or pinnatifid, the uppermost leaves linear, arrow-shaped, clasping with flat margins; the stem subcorymbose; the fruit shorter than the pappus, oblong, slightly attenuated upwards, with smooth ribs. This is the *C. tectorum* of Smith; but the true *tectorum* has revolute margins to its upper leaves, and other points of difference, and has never been found in Great Britain.

The other British species are—*C. pulchra*, a rare plant found in Scotland; *C. biennis*, also rare, found in chalky places in England; *C. succisæfolia*, common in woods in the north of England; *C. paludosa*, not uncommon in damp woods and shady places. *C. lacera* is considered to be a venomous plant in Naples, where it grows.

(Babington, *Manual of British Botany*.)

CREPUSCULA'RIA (Latreille), a section of Lepidopterous Insects, corresponding with the genus *Sphinx* of Linnæus. These insects occupy an intermediate station between the *Lepidoptera Diurna*, or Butterflies, and the *Lepidoptera Nocturna*, commonly called Moths. They have the following characters:—Antennæ growing gradually thicker towards the apex, at which part they are furnished with an elongated club, either fusiform or prismatic. Inferior wings furnished with a rigid bristle-like process at their base, which passes into a hook on the under surface of the superior wings, and serves to retain them. The larvæ are furnished with 16 legs, and many of them have a long horny process on the last segment of the body. The chrysalides are smooth, or sometimes furnished with small spines (but destitute of the points and angles usually observed in those of butterflies). They are either inclosed in a cocoon or buried in the earth. The larvæ sometimes feed upon wood, in which case they assume the pupa state within the tree or branch.

The families contained in this section are the *Sphingidæ*, *Sesiidæ*, *Ægeriidæ*, and the *Zygænidæ*.

CRESCENTIA, a genus of Plants, the type of the natural order *Crescentiaceæ*. It has a 2-leaved equal deciduous calyx; the corolla campanulate, with a fleshy tube much shorter than the ventricose 5-cleft unequal crisped limb; 4 stamens, didynamous, with the rudiment of a fifth; the fruit gourd-like, 1-celled, with a solid shell, internally pulpy, many-seeded. The species are large spreading trees, with solitary flowers rising from the trunk or branches.

C. Cujete, Cujete or Common Calabash-Tree, has oblong acute or obtuse leaves, cuneate at the base, and in fascicles. This plant is a native of the West India Islands and Spanish Main. It is a tree about 20 feet high, and is readily distinguished from all others by its habit. It sends out large horizontal branches, which bear fascicles of leaves at various distances. These leaves are from 4 to 6 inches long. The flowers are scattered over the older branches; the corolla is large, somewhat campanulate and constricted below the middle, which gives the upper part a ventricose character. It does not wither up as other corollas, but becomes putrid, giving out a nauseous and intolerable odour. The form and size of the fruit is very variable, being from 2 inches to 1 foot in diameter. It is covered with a thin skin, of a greenish-yellow colour when ripe, and under this is a hard woody shell which contains a pale yellowish soft pulp, of a tart unpleasant flavour, surrounding a great number of flat seeds. The shell is of great use to the inhabitants; the smaller oblong ones are formed into spoons and ladles, the larger ones form drinking cups, basins, and bowls for every variety of domestic purposes. They will even bear fire, and are used for boiling water in. The Caribs generally carve the outside of these vessels with a variety of grotesque figures. The pulp is sometimes eaten by the natives, but it is not much sought after. A syrup is prepared from it in the West Indies, which has a great reputation as a cough medicine. The pulp is also used as a poultice in cases of abscess or bruises. The leaves and branches and pulp of the fruit are eaten by cattle in times of scarcity. The wood of the tree is tough and flexible, and well adapted for the work of the coachmaker. There are three or four other species, natives of the West Indies and South America, having the same general characters as the above.

The species of *Crescentia* will grow in a mixture of loam, peat, and sand, and woody cuttings will grow when placed in sand in heat under a hand-glass. They do not however blossom in this country, as they require first to arrive at the full size.

(Don, *Dichlamydeous Plants*; Loudon, *Encyclopædia of Plants*; Lindley, *Flora Medica*.)

CRESCENTIACEÆ, a natural order of Plants formerly included in the *Solanaceæ*, allied to *Gesneraceæ* and *Bignoniaceæ*. The species are trees of small size, with alternate or clustered simple leaves without stipules. The flowers grow out of the old stems or branches; the calyx free, undivided, eventually splitting into irregular pieces; the corolla monopetalous, irregular, somewhat 2-lipped, with an imbricated æstivation. The stamens are four in number, growing on the corolla, didynamous, with the rudiment of a fifth between the posterior pair, which are the longest; anthers 2-lobed, bursting longitudinally; ovary free, surrounded by a yellow annular disc, 1-celled, composed of an anterior and posterior carpellary leaf, with 2 or 4 equidistant parietal placentæ, which sometimes meet and produce additional cells; ovules 0-0, horizontal; stylo 1; stigma of 2 plates. Fruit woody, not splitting, containing a multitude of large amygdaloid seeds buried in the pulp of the placentæ; skin leathery, loose; embryo straight, without albumen, with plano-convex fleshy cotyledons, and a thick short radicle next the hilum.

CRESS, the name given to various Plants with acrid or pungent leaves. Common Cress is *Lepidium sativum*; Water-Cress, *Nasturtium officinale*; Belleisle or Normandy Cress, *Barbarea præcox*; Indian Cress, *Tropæolum majus*. [LEPIDIUM; NASTURTIUM; BARBAREA; TROPÆOLUM.]

CRETACEOUS GROUP or FORMATION. [CHALK FORMATION.]

CREUSIA. [CIRRIPEDIA.]

CREX. [RALLIDÆ.]

CRIBELLA. [SOLASTERIÆ.]

CRICACANTHUS, a genus of Fossil Fishes, from the Mountain Limestone of Armagh. (Agassiz.)

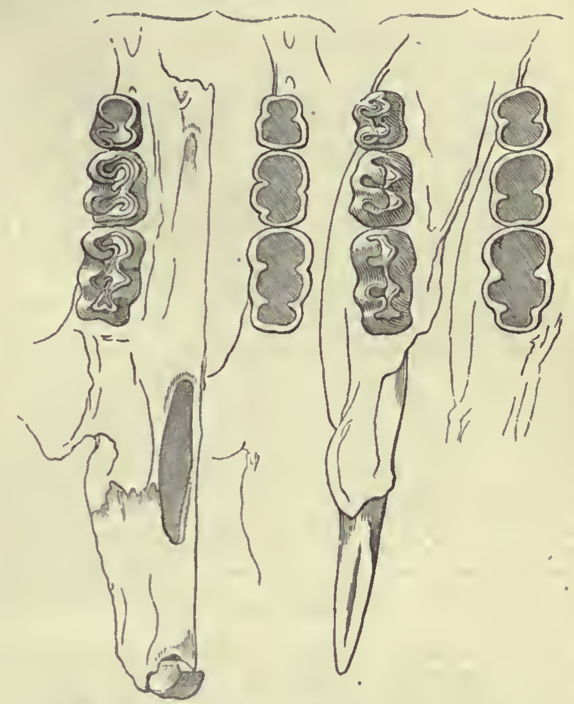
CRICETUS, the name of a genus of Rodents, whose economy makes them one of the most interesting of the great Linnæan genus *Mus*, or the family of *Muridæ* in its most extensive sense. The species have the following characters:—

Molar teeth simple; their crown furnished with blunt tubercles. Four toes and the vestige of a thumb on the fore feet; five toes on the hind feet; nails robust. Tail short and hairy.

$$\text{Dental Formula :—Incisors, } \frac{2}{2}; \quad \text{molars, } \frac{3\text{—}3}{3\text{—}3} = 16.$$

The species are found over all the north of Europe and of Asia, the temperate countries of Persia, and the deserts of Astrakhan. If the Canada Pouched Rat (Hamster du Canada, *Cricetus bursarius* of Desmarest, *Mus bursarius* of Shaw) is to be considered a Hamster, Canada and the borders of Lake Superior must be added; and it must be remembered that the Tucan of Hernandez, an inhabitant of New Spain, is considered by some to be identical with this Canada Rat (Sir John Richardson thinks on insufficient grounds). But the last-mentioned zoologist places Desmarest's Canada Hamster under the genus *Geomys*, with a note of interrogation; and Say has given it a generic distinction under the name of *Pseudostoma*.

C. vulgaris, the Common Hamster, *Mus Cricetus* of Pallas, Le Hamster of Buffon and the French authors.



Teeth of Common Hamster (*Cricetus vulgaris*). F. Cuvier.

It is reddish-brown above; black below, with three great whitish spots on the sides; feet white; a white spot on the throat, and another on the breast. Length about 9 inches; tail 3 inches. Males bigger than females. Weight of some males from 12 to 16 ounces; weight of females seldom exceeding from 4 to 6 ounces.

Common Hamster (*Cricetus vulgaris*). F. Cuvier.

Variations in colour are not uncommon. There is one variety entirely black. Pennant figures one which is entirely black, with the exception of the edge of the ear, the muzzle, the under-jaw and feet.

It is found in the north of Europe and Asia (Lesson), Austria, Silesia, and many parts of Germany, Poland, and the Ukraine; all the southern and temperate parts of Russia and Siberia; and even about the river Yenesei, but not farther to the east. In the Tartarian deserts, in sandy soil: they dislike moist places. Swarming in Gotha. (Pennant.)

The Common Hamsters are ill friends to the farmers. The quantity of grain which they consume is very great, nor does the destruction stop with mere satiety of appetite; the animal never forgets its hoard, and fills its two cheek-pouches till they seem bursting with the booty. They are also said to be very fond of the seeds of liquorice. Their dwellings are under the earth; their mode of forming them, and the purposes to which they apply them, have been thus described:—They first form an entrance, burrowing down obliquely. At the end of this passage one perpendicular hole is sunk by the male; the female sinks several. At the end of these they excavate various vaults, some as lodges for themselves and young, some as storehouses for their food. Every young one is said to have its separate apartment; each sort of grain its different vault. The 'living apartments,' as they may be called, are lined with straw or grass. The vaults are said to be of different depths, according to the age of the constructor: a young hamster, it is stated, makes them scarcely a foot deep, an old one sinks to the depth of four or five feet; and the whole 'curtilage,' so to speak, is sometimes eight or ten feet in diameter. From the mode of proceeding in their work, the reader will be prepared for the statement that the male and female live in separate apartments; and indeed it appears that, excepting at the short season of courtship, they have very little or no intercourse. Pennant gives them a very unamiable character. "The whole race," says that zoologist, "is so malevolent as to constantly reject all society with one another. They will fight, kill, and devour their own species, as well as other lesser animals; so may be said to be carnivorous as well as granivorous. If it happens that two males meet in search of a female, a battle ensues; the female makes a short attachment to the conqueror, after which the connection ceases. She brings forth two or three times in a year, and produces from 16 to 18 young ones at a birth: their growth is very quick, and at about the age of three weeks the old one forces them out of the burrows to take care of themselves. She shows little affection for them; for if any one digs into the hole, she attempts to save herself by burrowing deeper into the earth, and totally neglects the safety of her brood; on the contrary, if she is attacked in the season of courtship she defends the male with the utmost fury."

The harvest of these animals commences in August. Grains of corn, ears of corn, peas and beans in the pods, all find their way into their cheek-pouches, which will hold a quarter of a pint English. This forage is carefully cleaned in their burrows, and the husks and chaff carried out. When all is in order, they stop up the entrance and prepare for their hybernation, which lasts during the whole of the severe season; the provision they have made having been collected for the purpose of their support before their torpidity actually commences, and also in the spring and summer before the season has produced a supply for them in the fields. If all tales be true, they are a bold generation, and will jump at a horse if he tread near them, and hang by its nose so as to be disengaged with difficulty. Their voice is said to be like the barking of a dog. Fierce as they are, they quail before their deadly enemy the pole-cat, which, chasing them into their holes, destroys them unrelentingly. Notwithstanding this check, they are said to be so numerous in some seasons as to occasion a dearth of corn.

The fur of the animal is said to be valuable; and the peasant, when he 'goes a Hamster-nesting' in the winter, not only possesses himself of the skin of the plunderer, but of the plunder, which is said commonly to amount to two bushels of good grain in each magazine. Buffon, quoting Sulzer, says that in Gotha, where these animals were proscribed on account of their vast devastations among the corn, 11,564 of their skins were delivered at the Hôtel-de-Ville of the capital in one year, 54,429 in another, and 80,139 in a third.

There are four or five other species of this genus.

Professor Kaup records *Cricetus vulgaris fossilis*, from the Epplesheim sand.

CRICHTONITE. [TITANIUM.]

CRICKET, FIELD. [GRYLLIDÆ.]

CRICKET, HOUSE. [GRYLLIDÆ.]

CRICOPORA, a genus of Corals formed by Blainville out of a subdivision of the *Milleporidæ*, including some fossil species, which chiefly occur in the Oolitic Formations. *C. straminea* is found near Scarborough; *C. cæspitosa* near Bath.

CRINOIDEA. [ENCRINITES.]

CRINUM, a genus of Plants belonging to the natural order *Amaryllidaceæ*. It has a tubular long perianth, with a spreading reflexed or equal limb; 6 stamens, spreading or declinate, inserted into the orifice of the tube; the ovules hardly separable from their fleshy placentæ; the capsule membranous, bursting irregularly; the seeds globose, with a fleshy testa, giving them the appearance of small tubes. The species are handsome plants, and many of them form the greatest ornaments of our gardens.

C. Asiaticum, Poison Bulb (*Radix toxicaria*, Rumph.), has a cylindrical bulb above ground; the leaves lanceolate, smooth at the edge, longer than the scape, flowers on stalked umbels, the segments long, linear, reflexed; the ovary inferior; the style as long as the stamens, declinate; the fruit membranaceous, subglobose. The bulbs of this plant are powerfully emetic, and are used in Hindustan for the purpose of producing vomiting after poison has been taken, especially that of the Antiaris. It is a native of the East Indies.

C. amabile has a very large bulb with a long red neck, the leaves broad, glaucous, smooth at the edge; the umbels many-flowered; the tube shorter than the limb. This plant is a native of the East Indies, but is now common in our greenhouses. Many of the species have been lately introduced. They grow best in a rich loam mixed with a little rotten dung. They should be potted in large pots, where they will flower abundantly. They may be propagated by suckers from the roots, or they may be raised from seed. Should the plant show any indisposition to put out suckers it should be cut down near to the root, when it will put out plenty.

(Lindley, *Flora Medica*; Loudon, *Encyclopædia of Plants*; Herbert, *Amaryllidaceous Plants*.)

CRIOCERATITES. The discoidally spiral *Ammonitidæ*, whose whorls do not touch each other, receive this generic title. The species occur in the Oolitic and Lower Cretaceous Strata. [AMMONITES.]

CRIOCERIDÆ (Leach), a family of Coleopterous Insects, of the sub-section *Eupoda* and section *Tetramera*, distinguished by the following characters:—Mandibles truncated at the apex, or presenting two or three notches; labium generally entire, or but slightly emarginated; antennæ of moderate length, filiform, somewhat thickened towards the apex; the joints mostly of an obconic form; tarsi with the penultimate joint bilobed; femora often thick, especially towards the apex.

The principal genera contained in this family are—*Donacia*, *Hæmonia*, *Plauristes*, *Crioceris*, *Zeugophora*, *Auchenia*, and *Megacelis*.

The species of the genus *Crioceris* have the posterior femora of the same thickness as the others; the antennæ gradually enlarged towards the apex, the joints of which are scarcely longer than broad; the eyes are emarginated on the inner side: the thorax is narrower than the elytra, short, and usually of a somewhat cylindrical form: the elytra are elongate.

About eight species of this genus have been found in England, of which the most common is the *Crioceris Asparagi*, sometimes called the Asparagus Beetle, which is nearly a quarter of an inch in length, and of a blue-black colour; the thorax is red, with two black spots; the elytra are yellow, with the suture, two transverse bands, and a spot at the base, black.

This pretty little beetle is found in abundance in the south of England on asparagus plants; the larvæ are of a greenish hue, resemble little masses of jelly, and inhabit the same situations as the perfect insect. They subsist upon the leaves and soft part of the stalk of the asparagus plant.

CRIOCERUS. [EUPODA.]

CRISIA. [CELLARIÆA; POLYZOA.]

CRISTATELLA. [POLYZOA.]

CRITHMUM, a genus of Plants belonging to the natural order *Umbelliferæ*. The margin of the calyx is obsolete; petals roundish, entire, involute, ending in an obovate segment; transverse section of fruit nearly terete; mericarps with 5 elevated sharp rather winged ribs, lateral ribs a little broader than the rest, and marginating; pericarp spongy, with large cells; seed semi-terete, constituting a free nucleus which is covered with copious vittæ in every part. A suffruticose glabrous fleshy herb; petioles sheathing at the base; leaves bipinnate; leaflets oblong linear; umbels compound; involucre and involucels of many leaves; flowers white.

C. maritimum, Samphire, is a well known native of rocky seashores and cliffs along the Black Sea, in Tauria, the Mediterranean Sea; and of Europe, along the shores of the Western Ocean, from Spain to Britain, and of the Canary Islands; in Britain on the rocky sea-shore and cliffs. The root is branched and creeping extensively; the plant is greenish, salt, and pungently aromatic in flavour; the leaves biternate, the stems ascending; the flowers are white, anthers yellow. Samphire is a favourite ingredient in pickles. It is generally gathered in places where it is found wild, and the allusion to the practice by Shakespere in his description of the cliffs of Dover is well known. The plant is also used medicinally. Samphire is cultivated artificially in many places for the purposes of diet.

CROCIDOLITE, a Silicate of Iron of a lavender-blue or leek colour. It is called Blue Asbestus. It comes from Southern Africa.

CROCODILE. [CROCODILIDÆ.]

CROCODILIDÆ, *Crocodile-Tribe*, Crocodiles, a family of Saurians, comprising the largest living forms of that order of Reptiles. Duméril and others distinguish the family by the appellation of Aspidiot (shielded) Saurians; while many modern zoologists have considered them as forming a particular order. They form the *Loricata* of Merrem and Fitzinger, and the *Emydosaurians* of De Blainville.

Cuvier in his 'Règne Animal' describes the peculiarities of the family. The tail is flattened at the sides; there are five anterior and four posterior toes, of which the three inner ones only on each foot are armed with claws; all the toes are more or less joined by membranes. There is a single row of pointed teeth in each jaw, and the tongue is fleshy, flat, and attached very nearly up to the edges, which made the ancients believe that the Crocodile wanted that organ. The intromittent male organ of generation is single; the opening of the vent longitudinal. The back and tail are covered by great and strong squared scales, elevated into a ridge on their middle. There is a deeply dentilated crest on the tail, at the base of which the crest becomes double. The scales of the belly are squared, delicate, and smooth. The nostrils are opened at the end of the muzzle by two small crescent-shaped slits, closed by small valves, and lead by a long and straight canal pierced in the palatine and sphenoidal bones to the bottom of the back part of the mouth. As the lower jaw is prolonged behind the skull, the upper jaw has the appearance of mobility, and so the ancients wrote; but it only moves in concert with the whole of the head. The external ear is shut at will by means of two fleshy lips; and the eye has three lids. Under the throat are two small glandular orifices, whence issues a musky secretion.

The vertebræ of the neck bear upon each other by means of small false ribs, which render lateral motion difficult. Crocodiles therefore change their direction not without trouble, and they may be easily avoided by doubling, and escaping while they are employed in the laborious operation of turning round. They have no true clavicles; but their coracoid apophyses are attached to the sternum, as in all the other Saurians. Besides the ordinary and the false ribs, there are a set which protect the abdomen without reaching up to the spine, and which appear to be produced by the ossification of the tendinous portions of the recti muscles. Their lungs are not sunk in the abdomen like those of other reptiles, and there are fleshy fibres adhering to the part of the peritoneum which covers the liver, and which present the appearance of a diaphragm, which, joined to their trilocular heart, where the blood which comes from tho lungs is not mingled with that venous portion of it which comes from the body so completely as it is in the other reptiles, slightly approximates the Crocodiles to the warm-blooded quadrupeds. The auditory bone (caisse) and the pterygoid apophyses are fixed to the skull as in the tortoises.

The eggs of the Crocodiles are hard, and as large as those of the goose; and these reptiles are considered to be animals in which the extremes of size, taking that of the newly-hatched young and that of the full grown adult as the most remote points, present the widest difference. The females guard their eggs, and when they are hatched take care of the young during some months. (Cuvier.)

The dentition of the Crocodiles is peculiar. The teeth are numerous, large, of unequal length, conical, hollow at the base, disposed in a single row, and planted in the thickness of the edges of the superior and inferior maxillary bones, in separate cavities which may be considered as true alveoli. These teeth are hollowed at the base in such a manner as to serve for the case or sheath of the germ of the tooth destined to replace it, and which is to be of greater volume; so that, in Crocodiles, the number of the teeth does not vary with age as in many other animals.

Tooth of Crocodile, showing the incipient absorption of the hollow basal cone from the effect of the rising pressure of the advancing tooth.

Great solidity and strength are the results of this double gomphosis, and the alveoli are moreover directed obliquely from front to rear. The bony edges of the jaws whence these insulated teeth spring, are covered by a kind of gum. Another peculiarity of admirable adaptation to the necessities of the animal, may be observed in the interior of the mouth of the Crocodiles. Their palatine vault is nearly flat, and is not pierced by the extremities of the nasal fossæ, as in the majority of other reptiles. The posterior nasal apertures open in the pharynx behind the velum palati, which is sufficiently long to overspread that portion of the roof which is in front of the orifice of the glottis. They are probably the only reptiles which have a true pharynx, that is to say, a vestibule common to the posterior nostrils, the mouth, the larynx, and the œsophagus. This conformation, joined to the muscular structure of the tongue, and a peculiar expansion of the body of the os hyoides, produces a kind of cartilaginous disc or valve, which can be raised and applied to the velum palati above, so as to protect tho glottis, to which it serves tho office performed by the epiglottis in mammifers, while it confers on the reptile a peculiar power of deglutition and respiration, of the greatest consequence to its economy when it is below the surface of the water and has seized its prey in that situation; or, when the muzzle alone is above the surface, in carrying on respiration.

The following is a summary of the characters of the family *Crocodilidæ*.—Body depressed, elongated, protected on the back with solid and carinated scutcheons or shields; tail longer than the trunk, compressed laterally, annulated, and furnished with crests above; feet four, short, tho toes of the posterior feet united by a natatory membrane: each foot with three claws only; head depressed, elongated into a muzzle, in front of which are the nostrils approximated upon a fleshy tubercle, furnished with moveable suckers (soupapes): gape of the mouth extending beyond the skull; tongue fleshy, adherent, entire, not protractile; teeth conical, simple, hollowed at the base or towards the root, unequal in length, but placed in a single row; male genital organ simple, having its exit from the cloaca, which opens longitudinally. (Duméril and Bibron.)

No living species of this family is found in Europe, nor has any been yet detected in Australasia. The Alligators are peculiar to America; the species of *Crocodilus* are distributed in the Old and New World; those of *Gavialis* seem to be limited to the Ganges and the other large rivers of continental India.

Asia, besides the Gavial of the Ganges, produces at least three true crocodiles, viz. *Crocodilus vulgaris*, *C. galeatus* (*C. Siamensis*, Schneid.; *C. Siamensis*, Gray?), and *C. biporcatus*. Siam seems to be the principal, if not the only locality, where the first of these has been found; while the other two appear to be natives of those rivers which have their mouths in tho Indian Ocean and tho Ganges.

Africa, where neither Caimans (*Alligator*) nor Gavials have yet been discovered, is tho native country of the Crocodile à Bouclier, and *Crocodilus vulgaris*: it may also be the locality of *C. planirostris* of Graves and of Gray (*C. Gravesii*, Bory de St. Vincent); and *C. intermedius* of Graves and of Gray (*C. Journei*, Bory de St. Vincent), though their geographical position does not seem to be determined: these may perhaps come from the coast of Guinea. The only part of Africa whence the Crocodile à Bouclier has been received is Sierra Leone; while *Crocodilus vulgaris* seems to be spread over the whole of Africa, and is also an inhabitant of Madagascar. Numbers have been taken in the Nile, and one in the river Senegal. (Duméril and Bibron.)

America is most fruitful in Crocodiles, and possesses more species than Asia and Africa put together. True Crocodiles have never been detected on the continent. *C. acutus* has been found at Martinique and St. Domingo, and *C. rhombifer* at Cuba. The northern part of America is inhabited by one species only, *Alligator Lucius*, while four species, viz. *Alligator palpebrosus*, *A. sclerops*, *A. punctulatus*, and *A. cynocephalus*, inhabit the south. (Duméril and Bibron.)

Cuvier says that the *Crocodilidæ* inhabit fresh-water, that they cannot swallow while in the water, but drown their prey and place it in some nook under water, where they suffer it to putrefy before they eat it. This account seems to require some modification. Sir Charles Lyell, in his 'Principles of Geology,' observes that the larger Gangetic species descends beyond the brackish water of the Delta into the sea: and other instances are recorded of the true Crocodiles (but not of the Alligators) frequenting the mouths of large rivers, and even passing between different islands at considerable distances from each other. [ALLIGATOR.] This should be remembered by geologists. Then, as to their inability to swallow while in the water, those authors who describe their collective fishing expeditious, entirely contradict it. True it is, according to them, that the Alligators, after they have seized the fish from below, rise to the surface and toss the fish into the air to get rid of the water which they have taken in with it, catching it again in its descent: but it is clear that they swallow it without resorting to the land, though they go thither for the purpose of devouring those land animals which they have succeeded in capturing and drowning, after they have undergone some degree of decomposition.

"The laying of the eggs," says M. Ricord, "takes place in April and May, and the number amounts from 20 to 25, more or less, laid at many times. The female deposits them in the sand with little care, and scarcely covers them. I have met with them in the limo which the masons had left on the bank of the river. If I have reckoned right, the young come forth on the fortieth day, when the temperature is not too cold. At their birth they are 5 or 6 inches in length. They are hatched alone, and as they can do without nourishment while coming out of the egg, tho female is in no haste to bring it to them: she leads them towards the water and into the mud, and disgorges for them half-digested food. The male takes no account of them." The young preserve for some time the umbilical mark or cicatrice on the abdomen, whereby the vitellus was absorbed.

The *Crocodilidæ* are generally considered as forming a natural passage from the Saurians to the Chelonians, the last genera of which, in certain points of their conformation and habits, approximate nearly to the family under consideration.

The following is a synopsis of the species from the 'Catalogue of the Species in the British Museum':—

Fam. I. CROCODILIDÆ (Crocodiles).

The lower canines fitting into a notch in tho edge of the upper jaw. The hind legs with a fringe of compressed scales behind.

Synopsis of Genera.

* Teeth all uniform; nose of the male very large, inflated.

Gavialis.—Jaws very long, slender, sub-cylindrical. Cervical and dorsal discs united together.

** The ninth upper and eleventh lower teeth longer, like canines. Nose of both sexes simple.

Mecistops.—Jaws oblong, slender, depressed. Cervical and dorsal discs united. Hind feet webbed.

Crocodilus.—Jaws oblong, depressed. Nuchal, cervical, and dorsal discs separated from each other by small scales.

Gavialis.—Jaws very long, subcylindrical, slender, rather dilated and convex at the end. Teeth, canines two, quite anterior, small; lower canines shutting into a notch in the edge of the upper jaw. Feet fringed; toes webbed to the tip. The cervical plates united to and forming a disc with the dorsal ones. Males with a large swelling in front of tho nostrils. Native of Asia.

G. Gangeticus, the Gavial, or Nakoo.

Mecistops (Gray), *Gavialis* (Müller).—Jaws oblong, slender, depressed, flat, without ridges. Teeth unequal, lower canines fitting into a notch in the side of the upper jaw. Feet fringed; toes webbed to tho tip. The cervical plates in three or four cross series united to the dorsal shield. Males without any swelling in front of the nostrils.

M. Bennettii, Bennett's False Gavial.

M. cataphractus (*Crocodilus cataphractus* of Cuvier), the False Gavial.

M. Journei (*Crocodilus intermedius* of Graves), Journey's False Gavial.

Crocodilus.—Jaws oblong, depressed, tapering, rather dilated at the end. Teeth unequal, lower canines fitting into a notch in the side of the upper jaw. Feet fringed; toes webbed to the tip. Nuchal and cervical plates forming a disc separated from the dorsal one by small granular scales. The head of the newly hatched specimens is short, but it gradually elongates, and after a short time attains the form proper to the species; and, through the bones becoming more solid by increasing age, they only slightly alter the relative proportions of the different parts, so that the form of the head, taken with the shielding of the back, affords good characters for the determination of the species.

C. porosus, the Indian Crocodile.
C. bombifrons, the Large-Headed Indian Crocodile.
C. rhombifer, the Aque Palin.
C. Americanus, the American Crocodile.
C. marginatus, the Margined Crocodile.
C. vulgaris, the Egyptian Crocodile.
C. palustris, the Muggar, or Goa Crocodile.
C. trigonops, the Wide-Faced Crocodile.
C. planirostris, Graves's Crocodile.
C. Siamensis, the Siamese Crocodile.

Fam. II. Alligatoridæ (Alligators).

Synopsis of the Genera.

Canine teeth of the lower jaw fitting into a pit in the edge of the upper jaw. It is a native of the New World.

Jacare.—Jaws oblong, depressed, with a ridge across the face between the eyes. Hind feet scarcely webbed. Nostrils with a cartilaginous septum. Eyelids fleshy.

Alligator.—Jaws oblong, depressed, with a small longitudinal rib between the orbits. Hind feet webbed. Nostrils separated by a bony septum.

Caiman.—Jaws oblong, depressed. Hind feet scarcely webbed. Nostrils a cartilaginous septum. Eyelids with three bony plates.

Jacare.—Head oblong, depressed, with a ridge across the face before the eyes, rounded in front. Teeth unequal, canines of lower jaw each fitting into a pit in the upper jaw. Toes scarcely webbed. Nuchal and cervical plates united into one group. Eyelids fleshy, only partially bony. Nostrils only separated by a cartilage.

J. fissipes, the Broad-Headed Yacare.
J. sclerops, the Yacare.
J. nigra, the Black Yacare.
J. punctulatus, the Spotted Yacare.
J. vallifrons, Natterer's Yacare.

Alligator.—Jaws oblong, very depressed, broad, nearly parallel, rounded in front. Forehead with a small longitudinal ridge between the orbits. Teeth unequal, the lower canines received into a pit in the edge of the upper jaw. Nuchal and cervical plates separate. Feet fringed behind; toes half webbed, the outer front toe free. Nostrils separated by a bony septum arising from the outer edge. North America. The muzzle elongates by age.

A. Mississipensis (Gray), *A. Lucius* of others, the Alligator.

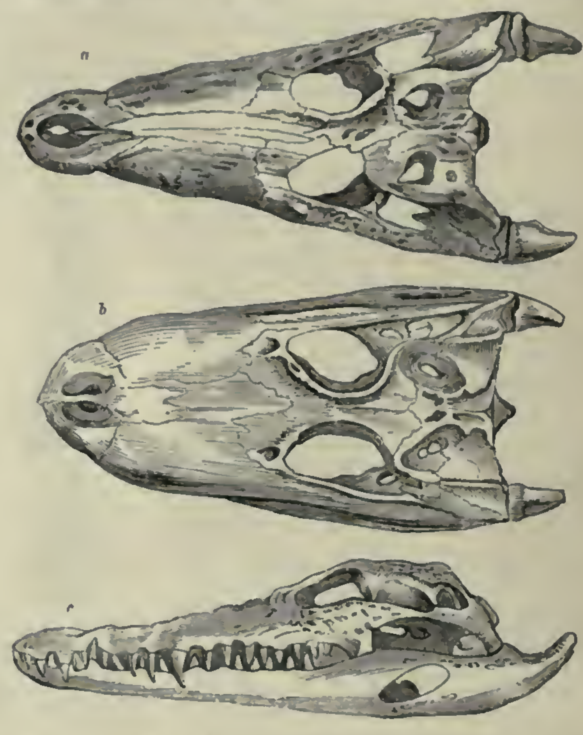
Caiman.—Jaws oblong, depressed, subpyramidical, rounded, and swollen at the end, without any frontal ridges or maxillary pits. Forehead flat and smooth. Teeth $\frac{19}{21}$, unequal, lower canine teeth fitting into a pit in the inner edge of the upper jaw. Eyebrows defended with three bony plates. Toes scarcely webbed. Nuchal and cervical plates united into one group (?). Tropical America.

C. trigonatus.—The Trigonal Caiman.
C. palpebrosus.—The Eyebrowed Caiman.
C. gibbiceps.—The Swollen-Headed Caiman.

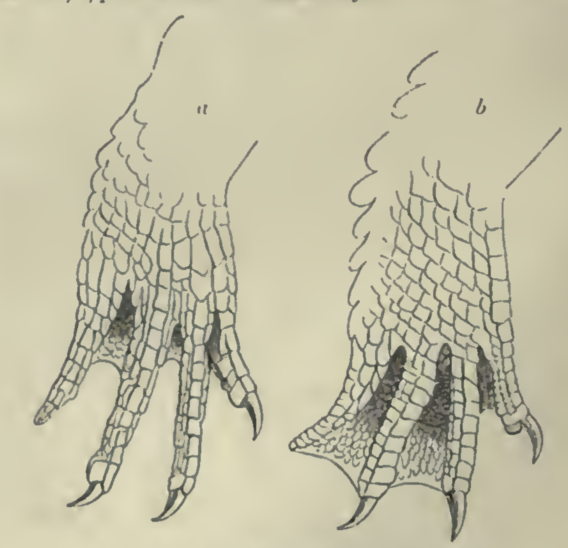
With regard to the differences between the above-named genera, Duméril and Bibron observe that nothing better distinguishes the Crocodiles from the Alligators than the narrowness of the muzzle behind the nostrils, a narrowness which is produced by the deep notch on each side of the upper mandible serving for the passage of the fourth lower tooth. The Gavials, it is true, have similar notches, which are destined for the same purpose; but at the extremity of the muzzle they have also two others for the reception of the front lower teeth; in lieu of this the front lower teeth in the Crocodiles pierce the upper mandible through and through. The horizontal contour of the head of the Crocodiles represents in general the figure of an isosceles triangle more or less elongated, depending upon the size of the jaws; but in no case is the muzzle wider than that of the Caimans, nor more slender than that of the Gavials. The Crocodiles have, like the former, their jaws festooned, as it were, on their sides, and their teeth unequal, but in less number, because they have never been observed with more than 19 on each side above, and 16 on each side below. The cranial holes are larger than they are in the Caimans, and less wide than they are in the Gavials. Their diameter is always found to be less than that of the orbits. The nasal aperture is oval or subcircular. There a very small bony plate in the thickness of the upper eyelid.

The same remark, as to the length of the head in proportion to its width at the three principal epochs of life, applies to the Caimans as well as to the Crocodiles.

The greater part of the Saurians of this group have the hind toes, the three external ones at least, united up to their extremity by a wide natatory membrane. There are indeed some nevertheless in which it is shorter, and one species, *Crocodilus rhombifer*, wants the membrane almost entirely, in the interval of the two inner toes. With about two exceptions, all the Crocodiles have the posterior border of the leg furnished with a dentilated crest formed of flattened scales. The two species which are said not to present this character are *Crocodilus planirostris* and *C. rhombifer*.



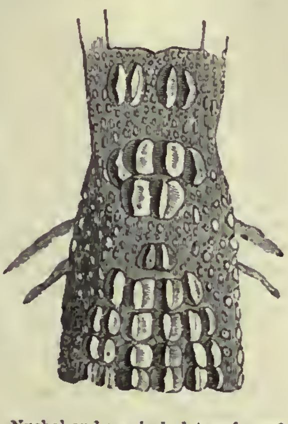
a, Skull of *Crocodilus vulgaris*, seen from above; *b*, skull of *Alligator Lucius*, same view; *c*, profile of skull of *Crocodilus vulgaris*.



a, hind foot of Caiman; *b*, hind foot of Crocodile.

Only one species among the Crocodiles (*Mecistops Bennettii*, *C. cataphractus*) has its cervical scales similar, in regard to the extent which they occupy on the neck, to those of the Caimans; that is to say, they form a long band commencing behind the nape, and prolonging themselves to the first dorsal plates. In the others, the cervical armour occupies about the middle of the neck; so that there remains before and behind it a considerable space devoid of bony pieces. The scales which cover the sides of the body are flat in some, carinated in others, and there are some which are provided with both sorts. The carinæ springing from the tail-plates to form the crest which surmounts that part are in general lower, of less consistence, and less stiff than those in the Caimans. *Crocodilus rhombifer* must however be excepted; for the caudal crest of that species is very low, and, so to speak, osseous.

Zoologists seem to be agreed in allowing that there is scarcely any genus of Reptiles the species of which are so difficult to be distinguished from each other as those of *Crocodilus. Crocodilus vulgaris*, the Egyptian Crocodile, may be taken as a type of the genus to which it belongs and of the whole family. It has the following characters:—Jaws not elongated into a narrow beak. Hind feet largely palmated, and with a festooned crest along their posterior border. Six cervical plates. Dorsal scutcheons or shields quadrangular, and surmounted by six longitudinal rows of carinæ but little elevated.


Nuchal and cervical plates, &c., of *Crocodilus vulgaris*.

It is the *Crocodilus amphibius Niloticus*, Loch.; Le Crocodile du Nil, Daud.; *Crocodilus vulgaris*, Cuv.; *Crocodilus vulgaris*, Tiedm.; Le Crocodile Vulgaire, Cuv.; the Common Crocodile, Griff., 'Animal Kingdom;' *Lacerta Crocodilus*, Linn.; *C. Champses*, Bory; *C. lacunosus*, Geoff.; *C. complanatus*, Geoff.

Messrs. Duméril and Bibron make four varieties of this species. The first variety has the following characters:—Muzzle a little narrowed, rather flat than arched across, with small hollows and channelings, which are now and then worm-shaped, on its surface. Table of the skull entirely flat. Back green, speckled with black; two or three oblique bands of the last-mentioned colour on each flank. The authors give the following synomyms:—

Crocodilus vulgaris, Geoff., 'Ann. Mus.' tom. x. p. 67; 'Descript. Egyp.' ('Hist. Nat.') tom. i. p. 8; Atlas, pl. 2, fig. 1, 2: *C. vulgaris*, 'Merr. Amph.' p. 37, spec. 9; *C. Champses*, Bory de St. Vincent, 'Dict. Clas.' tom. v. p. 105; *C. vulgaris*, Geoff., 'Crocod. d'Egypte,' p. 159; *C. lacunosus*, Geoff., 'Croc. d'Egypte,' p. 167; *C. vulgaris*, Gray, 'Synops. Rept.' part i. p. 57, spec. 1.

This, as well as the following variety, is that to which those individuals whose jaws are the least narrowed belong. The jaws have not indeed the same width in all, but it may be said generally that their width, when measured at the ninth upper tooth, is only one-seventh of the length of the head measured from the end of the nose to the occiput. There are some individuals of this variety whose upper mandible presents a nearly flat surface; that is to say, the extreme edge of its contour is the only part which declines towards the lower jaw. As an example of this group Messrs. Duméril and Bibron refer to the individual brought from Egypt by M. Geoffroy, and which both Cuvier and himself have taken as the type of *Crocodilus vulgaris*.

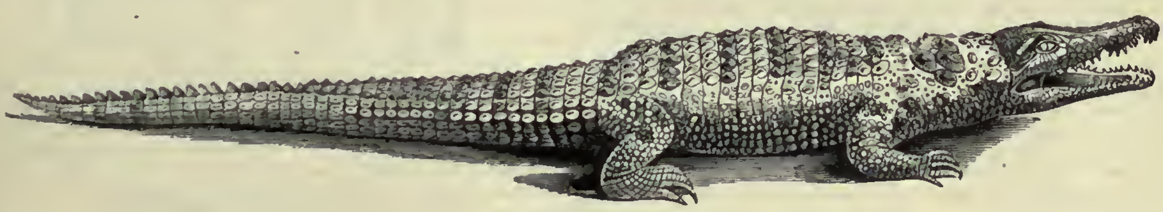
that historian to the locality of Elephantine alone, nor to any particular species. Geoffroy observes that the Crocodile still bears in Egypt the name of Temsa, which M. Champollion thought he recognised upon many papyri, as msbab, a word which he regarded as formed of the preposition 'm,' 'in,' and the substantive 'sah,' 'egg.' With regard to the Suchus, M. Champollion, the younger, states that the Egyptians gave the name of Souk to a deity which they represented as a man with a Crocodile's head. We refer those who wish to follow out this part of the subject more especially to the ancient authors above mentioned, to M. Geoffroy St. Hilaire, to Cuvier, and to the volume on Egyptian Antiquities in the 'Library of Entertaining Knowledge;' observing only that the Egyptians ornamented their tame Crocodiles by hanging rings of gold and precious stones in the opercula of their ears, which they pierced for the purpose, adorned their fore feet with bracelets, and presented them in this finery to the veneration of the people. They also fed them well. Cake, roast meat, and mulled wine were occasionally crammed and poured down their throats. Pliny, Ælian, and others, did little but copy what preceding writers had written upon this subject; but we learn from the former that the Romans first saw them in the ædileship of Scaurus, who showed five. Augustus introduced thirty-six of them into an amphitheatre at one time, where they were all killed by gladiators.

It is said that *Crocodilus vulgaris* is no longer seen in the Delta, but that it is found, sometimes in great numbers, in the Thebaid and the Upper Nile.

The characters of the genus *Gavialis* are given above.

The upper mandible of the Gavials is never pierced for the intromission of the teeth of the lower jaw, as it is in *Crocodilus;* but there are four large notches which serve as lodgments for the first and fourth pair of lower teeth. The Gavials are besides distinguished by the narrowness and length presented by the anterior part of their head and jaws, which resemble a sort of straight beak spread out at its origin, subcylindrical for the greatest part of its length, and terminating in a slight circular enlargement at its extremity. These jaws are rectilinear, and not undulated as in Alligator and *Crocodilus*. The number of teeth with which these narrow mandibles are armed is also greater than in either of the last-mentioned genera, amounting ordinarily in *Gavialis* to 118 or 120, all of which are equal, with the exception of those which compose the five or six first pairs above as well as below. The post-orbito-cranial holes are oval, and larger than they are in *Crocodilus*, for their diameter approaches that of the orbits themselves. The external orifice of the nasal fossæ, or rather of the long canal, which M. Geoffroy St. Hilaire has termed cranio-respiratory, is triangular. The membrane which closes this orifice has a considerable development in the males, and forms a large oval cartilaginous mass. This prominence is a kind of sac divided into two portions internally, the aperture of which is backwards and a little below. As in the Crocodiles, the eyelid contains in its substance a rudiment of a bony plate.

The hind feet of the Gavials are formed for the most part in the same manner as those of the majority of species of *Crocodilus;* that is to say, there are long and wide webs between the toes, and the posterior part of the leg is furnished with a dentilated crest. The cervical plates of the Gavials form a long band on the neck, as in the Caimans, and in one species only of Crocodile. The scales of the flanks are flat and


Egyptian Crocodile (*Crocodilus vulgaris*).

The second variety is the *C. palustris*, Less., 'Voy. Ind. Orient.'; Bell, 'Zool. Rept.' p. 305: *C. vulgaris*, var., E., Gray, 'Synops. Rept.' p. 58.

The third variety is *C. marginatus*, Geoff., 'Crocod. d'Egypte,' p. 165; *C. vulgaris*, var., B., Gray, 'Synops. Rept.' part. i. p. 58.

The fourth variety is the *C. complanatus, C. Suchus*, Geoff.

It may be expected that we should notice the ancient history of an animal held sacred by the Egyptians, and even elevated by them to the rank of a deity, for it was certainly one of the symbols of Typhon. Herodotus, Aristotle, Diodorus, Strabo, and Plutarch, will be read with interest on this subject. While it was worshipped in one part of Egypt under the name of Suchus or Souchis, it was eaten at Elephantine. Cuvier observes that the term Σοῦχος, or Σοῦχις, was only applied to the sacred individual, as Apis, Mnevis, and Pacis were appellations of the deified bulls of Memphis, Heliopolis, and Hermonthis respectively, and not intended to designate particular races of oxen. Geoffroy St. Hilaire is of a different opinion from Cuvier, who considered that Champsa,* as used by Herodotus, was not applied by

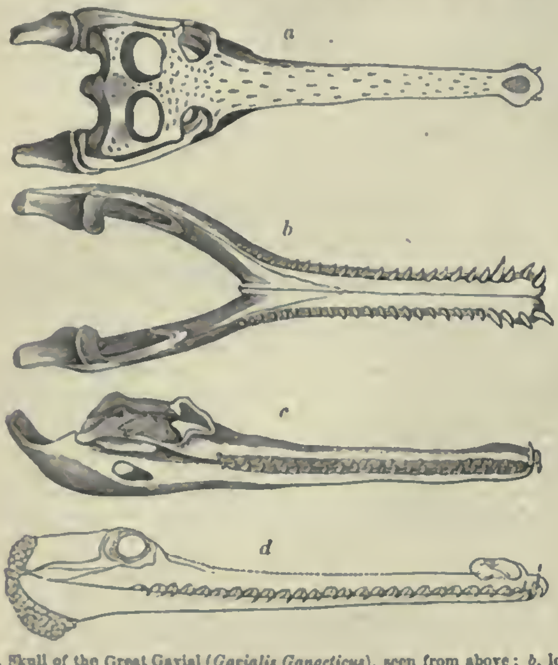
* Καλέονται δὲ οὐ κροκόδειλοι, ἀλλὰ χάμψαι—But they are not called Crocodiles, but Champsæ.

oval. The carinæ which surmount the bony pieces forming the dorsal cuirass are low, but the crest of the tail is very much elevated throughout the whole of its length.

The Caimans and Crocodiles, in their youth, have the head short in proportion to the size which it exhibits at their full growth. The contrary obtains among the Gavials, for in them the head is proportionally longer in youth than it is in age, so that it has the appearance of becoming shorter as the animal increases in size. (Duméril and Bibron.)

G. Gangeticus, the Narrow-Beaked Crocodile of the Ganges, Edw., 'Phil. Trans.' It is the *Crocodilus maxillis teretibus subcylindraceis*, 'Gronov. Zooph.;' *Crocodilus*, Merck, 'Hess. Beytr.'; *Lacerta Gangetica*, Gmel.; Le Gavial, Lacép., 'Hist. Quad. Ovip.;' Le Gavial, Bonn., 'Encyc. Méth.;' Crocodile du Gange ou Gavial, Fauj. Saint Fond, 'Hist. Mont. Saint-Pierre;' *Crocodilus longirostris*, Schneid., 'Hist. Amph.;' Le Gavial, Latr., 'Hist. Rept.;' Gangetic Crocodile, Shaw, 'Gener. Zool.;' *Crocodilus arctirostris, C. longirostris*, Daud., 'Hist. Rept.;' *C. longirostris, C. tenuirostris*, Cuv., 'Ann. Mus. Hist. Nat.;' *C. Gangeticus, C. tenuirostris*, Tied., Opp. und Liboschb, 'Naturg. Amph.;' *Gavialis longirostris, G. tenuirostris*, Merr., 'Amph.;' *Crocodilus* *longirostris*, *C. tenuirostris*, Cuv., 'Oss. Foss.;' Le Grand Gavial, Le Petit Gavial, Bory de St. Vincent, 'Dict. Class. d'Hist. Nat.;' *Crocodilus Gangeticus*, *C. tenuirostris*, Geoff., 'Mém. Mus. d'Hist. Nat.;' Le Gavial du Gange, Cuv., 'Reg. Anim.;' *Gavialis tenuirostris*, Guer., 'Icon. Reg. Anim.;' *Rhamphostoma tenuirostre*, Wagl., 'Naturl. Syst. Amph.;' *Gavialis Gangeticus*, Gray, 'Synops. Rept.;' the Gavial of the Ganges, Griff., 'Anim. Kingd.'

The head of the Gavial may be considered as framed of two parts; one anterior and long, almost cylindrical in form, more or less flattened; the other posterior and short, presenting the figure of a depressed hexahedron, wider behind than before. The jaws constitute the anterior part or beak, which is long, straight, and of extreme narrowness, but not, properly speaking, cylindrical. It is 4-sided, but the angles are rounded. It spreads out at its base and terminates in front, so as to recal to the observer the beak of the Spoonbill. Its vertical diameter is throughout less than its transversal diameter.



a, Skull of the Great Gavial (*Gavialis Gangeticus*), seen from above; *b*, lower jaw of Gavial, another individual; *c*, profile of the skull of Gavial; *d*, outline of the head covered with the integuments.

The head, properly so called, that is, the part situated behind the beak, has its sides straight and perpendicular. The upper surface is quadrilateral. The post-orbital portion is flat and smooth, except that one can perceive through the skin the subtriangular or ovoid holes with which the skull is dotted. The other portion is considerably inclined forwards, and mostly occupied by the eyes, the interval between which forms a slight gutter-like depression. The mandible is not continued from the forehead by a gradual slope as it is in the Crocodiles, but sinks suddenly to follow a straight and nearly horizontal direction, on a line with the inferior edge of the orbit. At the extremity of this upper mandible are the four notches for the passage of the first and fourth lower teeth when the mouth is shut. Two of these notches are very deep, and situated quite in front: the other two are moderate, and placed one on the right, the other on the left, behind the spatuliform termination of the beak, where it is slightly constricted.

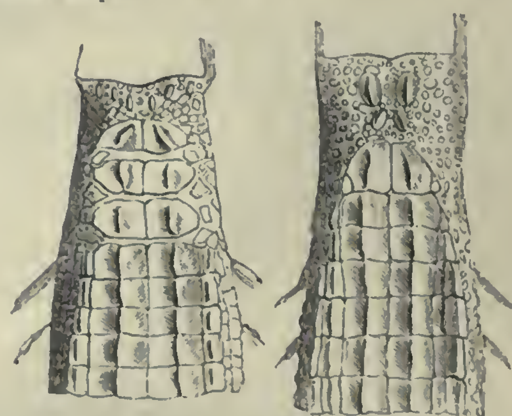
The division of the lower jaw into two branches does not commence till towards the twenty-second or twenty-third tooth. The first ten upper teeth, among which the two anterior teeth are the least separated, are implanted in the intermaxillary bone, and the greater portion of the teeth of the upper mandible are longer than the corresponding teeth of the lower jaw. Up to the nineteenth or twentieth pair they are turned a little outwards, so that when the mouth is shut the upper teeth pass over the sides of the lower jaw, and the lower teeth over the sides of the upper. The last six pairs are straight or nearly so, so that the points of the one set correspond exactly with the intervals of the other. The first, the third, and the fourth above, and the first, second, and fourth below, are the longest. They are in general a little curved and slightly compressed from before backwards, and are very slightly trenchant right and left. Hardly more than the last eight or nine on each side are nearly conical. Slight vertical ridges show themselves on the surface of the teeth of old individuals.

Under the throat, about the middle of the branches of the maxillary bone, are situated, one on the right and the other on the left side, the musky glands.

The external orifice of the nostrils opens on the upper side of the beak, at a small distance from its terminal border. The aperture is semilunar, at the bottom of which may be perceived a cartilaginous plate, which divides it longitudinally in two. The edges of this opening form two lips, which appear to have the power of approaching each other, so as to close the aperture hermetically. The anterior of these is curvilinear, and the posterior rectilinear; in the females and in young subjects they are very delicate and quite soft; but in the old males the anterior lip not only arrives at a cartilaginous consistence, but a development that carries it backwards as far as the seventh pair of teeth, and triples the thickness of the muzzle. This pouch, or cartilaginous sac, with two compartments, is of a sub-oval form, and is notched behind so as to form two very thick rounded lobes. Above these is, on the mesial line and in front, a cordiform prominence, on each side of which is a deep fold in the form of the letter S. This sac has its opening, which is common to it and the nostrils, below. This apparatus is the nasal purse or pouch (bourse nasale) of M. Geoffroy, and in his opinion performs the office of a reservoir of air for the animal when plunged beneath the surface of the water.

The anterior limb is nearly one-half longer than that part of the body which lies between the anterior and posterior limbs of the same side. The hinder limb is about two-thirds of the same interval. The third toe is longest in all the feet. The three middle toes of the fore foot are united at their base by a very short membrane: the other two toes are free, as well as the first toe of the posterior feet; but the second, third, and fourth of these last are united by a thick membrane with a free border, which is notched as it were semicircularly between the toes. The nails are slightly arched.

The nape supports two strong scutcheons, surmounted by a carina, more compressed behind than it is before. Their form is oval, and their height nearly equal to their width. There is sometimes a small scutcheon on each side of these. This is the case in one of the largest individuals; namely, that described by Lacépède, and figured by Faujas de Saint-Fond in his 'History of St. Peter's Mountain,' at Maestricht. The cervical scutcheons, to the number of four pairs, form a longitudinal band, which extends from two-thirds of the length of the neck to the dorsal shield. The first two are triangular, the six others quadrilateral. Each of them has a longitudinal carina on their mesial line, and there is a large scale on the left and on the right of the last pair.



Nuchal and cervical plates, &c., of two individuals of *Gavialis Gangeticus*, from Cuvier.

The upper part of the body is transversely cut by eighteen bands of osseous plates, with equal carinæ, which consequently form four longitudinal rows all down the back. The plates of the two lateral rows are squared, and rather smaller than those of the mesial rows, which are also four-sided; but their longitudinal diameter is less than their transversal. A longitudinal row of other carinated scutcheons borders this dorsal cuirass on the right and on the left for a part of its length. The flanks, the sides of the neck, and a portion of its upper part are covered with oval flat scales of moderate size. The tail is surrounded by from thirty-four to forty scaly circles, the number varying in different individuals. The dentilated crest does not become very perceptible till towards the sixth or seventh circle: its double portion terminates at the eighteenth or nineteenth. This crest is highest towards the middle of the tail, elsewhere it is delicate and flexible. The scales which clothe the lower parts of the body are quadrilateral, oblong, and perfectly smooth: there are nearly sixty transverse rows from the chin to the vent, and, like those of the flanks, they are all pierced with a small pore on the middle of their posterior border.

The limbs are protected above with rhomboidal scales: the anterior limbs on their external edge; the posterior limbs from the hock (jarret) to the little toe have a row forming a serrated edge. The surface of the natatory membranes is covered with granulous scales.

The ground-colour of the upper parts is a deep water-green, on which are often scattered numerous oblong irregular brown spots.

In young subjects the back and limbs are transversely banded with black. The lower region of the body is very pale yellow or whitish. The jaws are sprinkled with brown. The nails are of a clear horn colour. (Duméril and Bibron.)

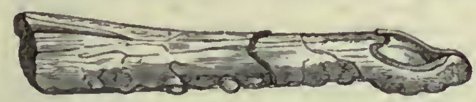
The Gavial of the Ganges is supposed to be the largest of the living Saurians. The measurement of the largest mentioned by Messrs. Duméril and Bibron is given at 5 metres, 40 centimetres (17 feet 8 inches).

Cuvier was led to think, principally from the figures published by Faujas de Saint-Fond, that there was more than one species of Gavial, and on subsequent inquiry distinguished two, the Great Gavial and the Little Gavial; but he was afterwards satisfied, from the examination of numerous specimens, that age alone made the difference between them.

Fossil Crocodilidæ.

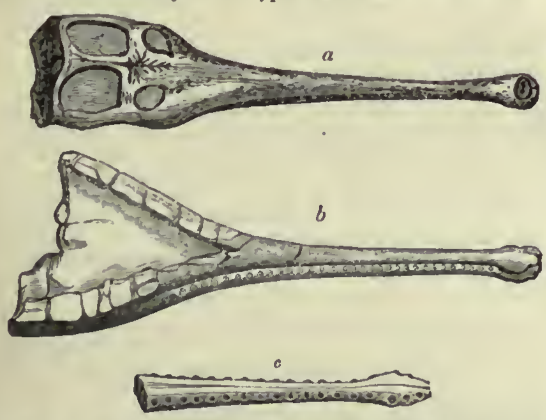
"In the living sub-genera of the Crocodilean family," observes Dr. Buckland ('Bridgewater Treatise,' p. 250), "we see the elongated and slender beak of the Gavial of the Ganges constructed to feed on fishes; whilst the shorter and stronger snout of the broad-nosed crocodiles and alligators gives them the power of seizing and devouring quadrupeds that come to the banks of rivers in hot countries to drink. As there were scarcely any *Mammalia* during the secondary periods, whilst the waters were abundantly stored with fishes, we might, à priori, expect that if any crocodilean forms had then existed, they would most nearly have resembled the modern Gavial: and we have hitherto found only those genera which have elongated beaks in formations anterior to and including the chalk; whilst true crocodiles with a short and broad snout like that of the caiman and the alligator appear for the first time in strata of the tertiary periods, in which the remains of *Mammalia* abound."

The genus *Steneosaurus* of Geoffroy St. Hilaire appears to come the nearest in its conformation to the living Gavial, and a general idea of the structure of the muzzle and anterior nasal aperture will be derived from the following cut of a specimen from Havre; whilst



Muzzle of *Steneosaurus*, from Dr. Buckland, who quotes De la Beche.

in *Teleosaurus* (Geoff.), though there is considerable similarity in the general contour of the head and jaws, the conformation of the muzzle and nasal aperture is very different from that of the living Saurian, the anterior termination of that aperture forming almost a vertical section of the extremity of the upper mandible.



a, head of *Teleosaurus Chapmanni*, seen from above; *b*, head of another individual of the same species seen from below, showing the lower jaw: locality of both, Lias in the neighbourhood of Whitby; *c*, inside view of anterior extremity of lower jaw: locality, Great Oolite at Enslow near Woodstock, Oxon. From Dr. Buckland.

Anterior extremities of the beak or jaws of *Teleosaurus*. Locality, Great Oolite, Stonesfield, Oxon. From Dr. Buckland.

In his monograph on the 'Fossil Reptilia' of the London Clay, published by the Palæontographical Society, Professor Owen describes the following species of extinct Emydosaurians.

Crocodilus Toliapicus. It is the Crocodile de Sheppey of Cuvier; *C. Spenceri* of Buckland, in his 'Bridgewater Treatise,' and of Rose in the 'Reports of the British Association,' 1841.

It was found originally in the Eocene beds of Sheppey, and was first described by Baron Cuvier from a specimen in the collection of M. Deluc of Geneva. Professor Owen doubts if the skull figured by Dr. Buckland (and given below) as *C. Spenceri* is identical with a more perfect specimen of this species now in the British Museum, from which he has given his own description.

Skull of *Crocodilus Spenceri*. Buckland.

C. Champsoides (Owen). This species seems also to have been included in Buckland's *C. Spenceri*, and Cuvier's Crocodile de Sheppey. This species has been established from a skull in the possession of Mr. Bowerbank, and although not to be clearly identified with Buckland's *C. Spenceri* more nearly resembles it than *C. Toliapicus.*

"The evidences," says Professor Owen, "of Crocodilean Reptiles from the deposits at Sheppey, less characteristic than those above described, are abundant. Mr. Bowerbank possesses numerous rolled and fractured vertebræ, condyloid extremities, and other portions of long bones, with fragments of jaws and teeth." In relation to the two Sheppey species he says, "Amongst the existing species of Crocodile, the *C. acutus* of the West Indies offers the nearest approach to the *C. Toliapicus*; and the *C. Schlegelii* of Borneo most resembles the *C. Champsoides.*"

C. Hastingsiæ (Owen). The specimen upon which this species is established was discovered by the Marchioness of Hastings in the Eocene Fresh-Water deposits of the Hordwell Cliffs in Hampshire, which her ladyship has described in the volume of 'Reports of the British Association' for 1847.

Alligator Hantoniensis (Searles Wood). The specimens of this fossil differ from the last in the exposed condition of the inferior canines when the mouth is shut. Although this distinction is sufficient to separate the existing species of Crocodiles and Alligators, Professor Owen is inclined to doubt whether it may not be in this case a mere accidental variety.

Gavialis Dixoni (Owen). The remains on which this species is established were discovered by the late Mr. Frederick Dixon in the Eocene deposits of Bracklesham.

In concluding the monograph in which these Fossil Crocodiles are minutely described and figured, and the skeletal anatomy of the family treated at large, Professor Owen says, "On reviewing the information which we have derived from the study of the fossil remains of the Procœlian *Crocodilia* that have been discovered in the Eocene deposits of England, the great degree of climatal and geographical change, which this part of Europe must have undergone since the period when every known generic form of that group of reptiles flourished here, must be forcibly impressed upon the mind.

"At the present day the conditions of earth, air, water, and warmth, which are indispensable to the existence and propagation of these most gigantic of living Saurians, concur only in the tropical or warmer temperate latitudes of the globe. Crocodiles, Gavials, and Alligators now require, in order to put forth in full vigour the powers of their cold-blooded constitution, the stimulus of a large amount of solar heat, with ample verge of watery space for the evolutions which they practise in the capture and disposal of their prey. Marshes with lakes, extensive æstuaries, large rivers, such as the Gambia and Niger that traverse the pestilential tracts of Africa, or those that inundate the country through which they run, either periodically, as the Nile for example, or with boundless forest and savannahs, like those ploughed in ever varying channels by the force of the mighty Amazon or Orinoco,—such form the theatres of the destructive existence of the carnivorous and predacious Crocodilean Reptiles. And what then must have been the extent and configuration of the Eocene continent which was drained by the rivers that deposited the masses of clay and sand accumulated in some parts of the London and Hampshire basins to the height of 1000 feet, and forming the graveyard of countless Crocodiles and Gavials. Whither tended that great stream once the haunt of alligators and the resort of taper-like quadrupeds, the sandy bed of which is now exposed on the upheaved face of Hordwell Cliff? Had any of the human kind existed and traversed the land where now the base of Britain rises from the ocean, he might have witnessed the Gavial cleaving the waters of its native river with the velocity of an arrow, and over and anon rearing its long and slender snout above the waves, and making the banks re-echo with the loud and sharp snapping of its formidably armed jaws. He might have watched the deadly struggle between the Crocodile and Palæothere, and have been himself warned by the hoarse and deep bellowings of the Alligator from the dangerous vicinity of its retreat. Our fossil evidences supply us with ample materials for this most strange picture of the animal life of ancient Britain; and what adds to the singularity and interest of the restored 'tableau vivant' is the fact, that it could not now be presented in any part of the world. The same forms of Crocodilean Reptile it is true still exist, but the habitats of the Gavial and the Alligator are wide asunder, thousands of miles of land and ocean intervening: one is peculiar to the tropical rivers of continental Asia, the other is restricted to the warmer latitudes of North and South America; both forms are excluded from Africa, in the rivers of which continents true Crocodiles alone are found. Not one representative of the Crocodilean order naturally exists in any part of Europe: yet every form of the order once flourished in close proximity to each other in a territory which now forms part of England."

CROCOISITE, a native Chromate of Lead. [LEAD.]

CROCUS, a beautiful genus of Iridaceous Plants, consisting of many hardy species, some of which are among the commonest ornaments of gardens. Crocuses are chiefly found in the middle and southern parts of Europe and the Levant, three only being wild with us, namely *Crocus nudiflorus*, which is abundant in the meadows near Nottingham, *C. vernus* and *C. sativus*. Botanists have found it extremely difficult to ascertain by what precise technical marks the species are to be distinguished. We do not propose to occupy ourselves with that subject, but shall rather enumerate briefly the names and localities of such as are apparently distinct; so that those who wish to form a complete collection of these pretty flowers may know where to look for them, and when their task is accomplished.

* Vernal Species.

C. vernus. This is the common Purple or White Crocus of our gardens in the spring. It has produced a multitude of florists' varieties, some of which are extremely beautiful and well marked. Its root-coats are finely netted, its flowers scentless, and the throat of the tube of the flower covered with hairs. *C. albiflorus* and *C. obovatus* are varieties of it. It is said to be wild in some parts of England, but it may have been introduced. It is certainly wild on the Alps, particularly of the Tyrol, Piedmont, Switzerland, Salzburg, and Carinthia, descending to the sea-coast at Friuli. It is also found on the mountains of the Abruzzi and elsewhere, in similar situations in the kingdom of Naples, associating itself with oaks, chestnuts, and similar trees, and not existing at elevations exceeding 6000 feet.

C. versicolor, the common Sweet-Scented Variegated Spring Crocus. There are not many varieties of it, all of which are recognised by the root-coats not being cut circularly, the yellow tube of the flower hairless, and the sweet scent. It grows wild about Nizza (Nice), and in all the eastern parts of Provence.

C. biflorus, the Scotch Crocus. The beautiful pencilled sepals and clear or bluish-white petals of this species distinguish it at once; added to which the root-coats are cut round into circular segments, a circumstance that occurs in no other species. It is a native of the most southern parts of Italy; growing wild in sterile subalpine pastures in the kingdom of Naples, and in similar situations in Sicily. Our garden plants are merely a cultivated state of the *C. pusillus* of the Italians.

C. Imperati. This is little known in England. Its leaves appear long before the flowers, and are glaucous and spreading. The petals and sepals are a delicate violet inside, but externally white; the petals are almost whole-coloured and pale purple, except at the base; the sepals are strongly feathered with rich purple. A white and a whole-coloured variety of it are said to exist. It differs from *C. biflorus* in its root-coats being membranous, and not cut circularly, and from *C. versicolor* in the tube of the flower not being hairy. It inhabits low hills and woods in the kingdom of Naples, on Capri, on Mount S. Angelo di Castellamare, and elsewhere. It is supposed that *C. suaveolens* is at most only a variety of this.

C. luteus or *mæsiacus*, the Large Yellow Crocus. It is characterised by very large whole-coloured flowers, and large roots, with coarsely netted coats. It is an oriental plant, but its exact locality is unknown.

C. aureus, the Small Yellow Crocus, by no means so common as the last, of which it is probably a variety. Its flowers are smaller and deeper coloured, and it has a pale cream-coloured variety. Dr. Sibthorp found it wild on the hills of the Morea.

C. susianus, the Cloth-of-Gold Crocus. This species is well known for its coarsely-netted root-skin, and small deep yellow flowers, the sepals of which are feathered with dark chocolate brown, and are rolled back when expanded under sunshine. It is a native of the Crimea, the Ukraine, and the other parts of south-western Russia: it is also believed to be a Turkish plant; and localities are given for it under the name of *C. reticulatus*, on mountains near Trieste, in woods near Lippizza, in Friuli, and in Hungary, in the lordship of Tolna. A remarkable variety with deep purple flowers exists, but it is extremely rare.

C. stellatus and *C. sulphureus* are pale and probably hybrid varieties of *C. luteus*. They have never been seen except in gardens, and are the least pretty of the genus.

* * Autumnal Species.

C. sativus, the common Saffron Crocus, an eastern plant, cultivated from time immemorial for the sake of its long reddish-orange drooping stigmas, which, when dried, form the saffron of the shops. Its Asiatic localities are not known; in Europe it grows apparently wild in the south of Tyrol, and is said to have been found near Ascoli, and on the Alps of Savoy. Its British station is in all probability to be ascribed to accident.

C. odorus, the Sicilian Saffron. This species, which has also been named *C. longiflorus*, is found in mountain pastures in Calabria, and in both mountainous and maritime situations through all Sicily, where its stigmas are collected instead of those of the true saffron. Its blossoms are sweet-scented, and are known at first sight from the stigmas not hanging out of the flower, but standing upright and inclosed within it. The tube of its flower is very long.

C. Thomasii, a Calabrian plant, found in mountain woods. It is said to have coarsely-netted root-coats, fragrant saffron-like truncated stigmas inclosed within the flower, which appears long after the leaves, and has a bearded throat. It exists in English gardens, but is very rare.

C. nudiflorus. The flowers appear without the leaves, and the root-coats are slightly netted. The stigmas are divided into many deep narrow segments. The plant is not rare in many parts of Europe, flowering about the time of the *Colchicum*, to a small species of which it at first sight bears much resemblance. *C. speciosus*, *C. multifidus*, *C. medius*, are mere varieties or synonymous names of this plant.

C. serotinus. This requires to be compared with *C. odorus*, to which it approaches very nearly, if it be not the same thing.

The Crocus delights in a dry situation and a rich light sandy soil. In such a place and soil it flowers profusely and produces large roots; but in a wet poor soil it dwindles away. Slugs are the chief enemies of this plant, which may be destroyed by watering the beds or clumps with lime-water.

For a florist's account of the varieties of spring Crocuses cultivated in the gardens of this country, see the 'Transactions of the Horticultural Society of London,' vol. vii.

CRONSTEDTITE, a hydrous Silicate of Iron, occurring both massive and crystallised. Its primary form is a rhomboid, in small thin hexagonal prisms, and in radiating groups. The cleavage is perpendicular to the axis, distinct. The colour is black and brownish-black; streak, dull green. Hardness 2·0 to 2·5. Specific gravity 3·3 to 3·36. Lustre vitreous. Opaque. This mineral is found in Cornwall, Brazil, and Przibram in Bohemia. It has the following composition:—

Silica	22·45
Oxide of Iron	58·85
Oxide of Manganese	2·89
Magnesia	5·68
Water	10·70

CROSSARCHUS. [VIVERRIDÆ.]

CROSSBILL. [LOXIADÆ.]

CROSS-STONE. [STAUROTIDE.]

CROSSWORT. [GALIUM.]

CROTALIDÆ, a family of Reptiles belonging to the order Serpents or Snakes, and including those species known by the name of Rattle-Snakes. In the 'Catalogue of the British Museum' Dr. J. E. Gray constitutes *Crotalidæ* a family of his sub-order *Viperina*. The family has the following distinctions:—Face with a large pit on each side, placed between the eye and the nostril. The head large behind, crown flat, covered with scales or small shields; the jaws weak, the upper with long fangs in front and no teeth. The belly covered with broad band-like shields: anal spurs none. The species are all of them venomous and viviparous.

The following is a synopsis of the genera and species:—

A. Head covered with scales, having small shields on the edge of the forehead and eyebrows; tail ending in a spine; cheeks scaly.

a. Subcaudal plates two-rowed to the tip. *Craspedocephalina.*

Craspedocephalus.—Superciliary shield single, hinder labial shields large; scales lanceolate, keeled. America.

Species—*C. Brasiliensis*; *C. lanceolatus*; *C. atrox*; *C. elegans*; *C. trilineatus.*

Trimesurus. — Superciliary shield single, hinder labial shields smallest; scales lanceolate, keeled. Asia.

T. viridis; *T. albolabris*; *T. carinatus*; *T. purpureus*; *T. maculatus*; *T. subannulatus*; *T. Philippensis*; *T. strigatus*; *T. Sumatranus*; *T. formosus*; *T. Ceylonensis.*

Parias.—Superciliary shield single, hinder labial shields smallest; scales lanceolate, of head and body smooth, of crown unequal. Asia.

P. flavomaculatus; *P. ornatus*; *P. variegatus.*

Megæra.—Superciliary shield double, hinder labial shields smallest; scales lanceolate, of head and body smooth. Asia.

M. trigonocephala; *M. olivacea.*

Atropos.—Superciliary shields many, forming a prominent arched series. Asia.

A. acontia.

b. Subcaudal plates four-rowed at the tip. America. *Lachesina.*

Lachesis.—Head ovate; crown scaly.

L. mutus; *L. pictus.*

B. Head more or less shielded.

c. Subcaudal plates two-rowed; tail ending in a spine; cheeks not scaly; head-shields with some additional plates in front. *Trigonocephalina.*

Trigonocephalus.—Dorsal scales keeled.

T. Halys; T. affinis; T. Bromhoffi; T. rhodostoma; T. Hypnale; T. Azara.

d. Subcaudal plates one-rowed; tail ending in a spine; cheeks not scaly; head shielded. America. *Cenchrina.*

Cenchris.

C. contortrix; C. atrofuscus; C. piscivorus.

e. Subcaudal plates one-rowed; tail ending in a rattle; cheeks scaly; head more or less shielded. America. *Crotalina.*

Crotalophorus.—Head with nine large shields extending behind the eyes.

C. miliaris; C. tergeminus; C. Kirtlandi.

Uropsophus.—Head with scales behind; temporal scales and labial shield moderate.

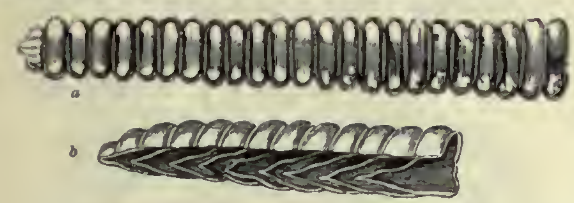
U. decussus.

Crotalus.—Head with scales behind; temporal scales and labial shields very small, convex.

C. horridus.

The last species, *C. horridus*, the Rattle-Snake, may be taken as a type of the whole family.

The colour of the head is brown; eye red; upper part of the body yellowish-brown, transversely marked with irregular, broad, black lists. Rattle brown, composed of several horny membranous cells, of an undulated pyramidal figure, articulated one within the other, so that the point of the first cell reaches as far as the basis or protuberant ring of the third, and so on; which articulation, being very loose, gives liberty to the parts of the cells that are inclosed within the outward rings to strike against the sides of them, and so to cause the rattling noise which is heard when the snake shakes its tail. (Catesby.)



a, Rattle of twenty-four joints; *b*, section of rattle.

It is a native of Virginia, the Carolinas, and other parts of America.

Lawson, in his 'History' (1714), says, "The Rattle-Snakes are found in all the main of America that I ever had any account of; being so called from the rattle at the end of their tails, which is a connection of jointed coverings of an excrementitious matter, betwixt the substance of a nail and a horn, though each tegmen is very thin. Nature seems to have designed these on purpose to give warning of such an approaching danger as the venomous bite of these snakes is. Some of them grow to a very great bigness, as six feet in length, their middle being the thickness of the small of a lusty man's leg. We have an account of much larger serpents of this kind; but I never met them yet, although I have seen and killed abundance in my time. They are of an orange-tawny and blackish colour on the back; differing (as all snakes do) in colour on the belly, being of an ash-colour inclining to lead. The male is easily distinguished from the female by a black velvet spot on his head; and besides his head is smaller shaped and long. Their bite is venomous if not speedily remedied; especially if the wound be in a vein, nerve, tendon, or sinew; when it is very difficult to cure. The Indians are the best physicians for the bite of these and all other venomous creatures of this country. There are four sorts of snake-roots already discovered, which knowledge came from the Indians, who have performed several great cures. The rattle-snakes are accounted the peaceablest in the world; for they never attack any one, or injure them, unless they are trod upon or molested. The most danger of being bit by these snakes is for those that survey land in Carolina; yet I never heard of any surveyor that was killed or hurt by them. I have myself gone over several of this sort, and others; yet it pleased God I never came to any harm. They have the power or art (I know not which to call it) to charm squirrels, hares, partridges, or any such thing, in such a manner, that they run directly into their mouths. This I have seen by a squirrel and one of these rattle-snakes; and other snakes have in some measure the same power. The rattle-snakes have many small teeth, of which I cannot see they make any use; for they swallow everything whole; but the teeth which poison are only four; two on each side of their upper jaws. These are bent like a sickle, and hang loose as if by a joint. Towards the setting on of these, there is, in each tooth, a little hole wherein you may just get in the point of a small needle. And here it is that the poison comes out (which is as green as grass) and follows the wound made by the point of their teeth. They are much more venomous in the months of June and July, than they are in March, April, or September. The hotter the weather the more poisonous. Neither may we suppose that they can renew their poison as oft as they will; for we have had a person bit by one of these who never rightly recovered it, and very hardly escaped with life; a second person bit in the same place by the same snake, and received no more harm than if bitten with a rat. They cast their skins every year, and commonly abide near the place where the old skin lies. These cast-skins are used in physic, and the rattles are reckoned good to expedite the birth. The gall is made up into pills with clay, and kept for use, being given in pestilential fevers and the small-pox. It is accounted a noble remedy, known to few, and held as a great arcanum. This snake has two nostrils on each side of his nose. Their venom, I have reason to believe, effects no harm any otherwise than when darted into the wound by the serpent's teeth."

Catesby thus notices this species in 1771:—"Of these vipers," says he, writing of all the American venom-snakes under that name, "the rattle-snake is most formidable, being the largest and most terrible of all the rest: the largest I ever saw was one about eight feet in length, weighing between eight and nine pounds. This monster was gliding into the house of Colonel Blake of Carolina; and had certainly taken his abode there undiscovered, had not the domestic animals alarmed the family with their repeated outcries; the hogs, dogs, and poultry united in their hatred to him, showing the greatest consternation, by erecting their bristles and feathers, and, expressing their wrath and indignation, surrounded him, but carefully kept at a distance; whilst he, regardless of their threats, glided slowly along.

"It is not uncommon to have them come into houses, a very extraordinary instance of which happened to myself in the same gentleman's house, in the month of February, 1723: the servant in making the bed in a ground-room (but a few minutes after I left it), on turning down the clothes discovered a rattle-snake lying coiled between the sheets in the middle of the bed.

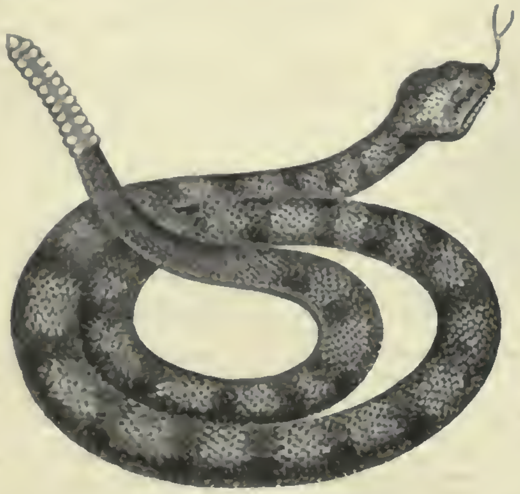
"They are the most inactive and slow-moving snake of all others, and are never the aggressors except in what they prey upon; for unless they are disturbed they will not bite; and, when provoked, they give warning by shaking their rattles. These are commonly believed to be the most deadly venomous serpent of any in these parts of America: I believe they are so, as being generally the largest, and making a deeper wound, and injecting a greater quantity of poison; though I know not why any of the other kinds of vipers may not be as venomous as a rattle-snake, if as big, the structure of the deadly fangs being alike in all. The most successful remedy the Indians seem to have, is to suck the wound, which, in a slight bite, has sometimes a good effect; though the recovered person never fails of having annual pains at the time they were bit. They have likewise some roots which they pretend will effect the cure; particularly a kind of *Asarum*, commonly called Heart Snake-Roots, a kind of *Chrysanthemum* called St. Anthony's Cross, and some others; but that which they rely on most, and which most of the Virginian and Carolina Indians carry dry in their pockets, is a small tuberous root, which they procure from the remote parts of the country; this they chew, and swallow the juice, applying some to the wound. Having, by travelling much with Indians, had frequent opportunities of seeing the direful effects of the bites of these snakes, it always seemed and was apparent to me that the good effects usually attributed to these their remedies is owing more to the force of nature, or the slightness of the bite of a small snake in a muscular part, &c. The person thus bit I have known to survive without any assistance for many hours; but where a rattle-snake with full force penetrates with his deadly fangs, and pricks a vein or artery, inevitable death ensues; and that, as I have often seen, in less than two minutes. The Indians know their destiny the minute they are bit; and when they perceive it mortal, apply no remedy, concluding all efforts in vain. If the bite happeneth in a fleshy part, they immediately cut it out to stop the current of the poison. I could heartily wish that oil of olives applied to the wound might have as good success against the venom of these snakes as it hath been found in England to have had against the poison of the adder." (Catesby, 'Natural History of Carolina.')

Lawson, it appears, was an eye-witness of the fascination, if so the effect of terror on the victim is to be termed, of the Rattle-Snake; and though Catesby never saw it, he thus details the evidence of the fact known to him:—

"The charming, as it is commonly called, or attractive power this snake is said to have of drawing to it animals and devouring them, is generally believed in America. As for my own part, I never saw the action, but a great many from whom I have had it related all agree in the manner of the process; which is, that the animals, particularly birds and squirrels (which principally are their prey), no sooner spy the snake, than they skip from spray to spray, hovering and approaching gradually nearer their enemy, regardless of any other danger; but with distracted gestures and outcries descend, though from the top of the loftiest trees, to the mouth of the snake, who openeth his jaws, takes them in, and in an instant swallows them."

There can be little doubt that this supposed power is greatly exaggerated. That a suddenly-surprised animal should be arrested by terror and easily fall a victim to the serpent, is highly probable; but that it should descend to its destruction from the top of the loftiest trees, is almost incredible.

That the secretion of the poison may be greatly increased by local irritation would be expected; and Mr. Bell, in his 'History of British Reptiles,' adduces the following as evidence of the fact. He was dissecting very carefully and minutely the poison-apparatus of a large rattle-snake which had been dead for some hours; the head had been taken off immediately after death; yet as Mr. Bell continued his dissection the poison continued to be secreted so fast as to require to be occasionally dried off with a bit of rag or sponge. He states his belief that there could not have been less altogether than six or eight drops at the least.



Rattle-Snake (*Crotalus horridus*).

The same scientific and entertaining author relates, as a proof that the effect of wounds inflicted by venomous serpents subsequently to the first is greatly lessened, either by the diminution of the quantity of venom or of some deterioration of its strength, the following anecdote:—A gentleman of his acquaintance had received a living rattlesnake from America. Intending to try the effect of its bite upon some rats, he introduced one of those animals into the cage with the serpent, which immediately struck the rat, and the latter died in two minutes. Another rat was then placed in the cage, and ran to the farthest corner from the snake, uttering cries of distress. The serpent did not attack it immediately; but after about half an hour, on being irritated, struck the rat, which exhibited no symptoms of being poisoned for several minutes, nor did it die till twenty minutes after the bite had been inflicted. A third rat, remarkably large, was then introduced into the cage, and exhibited no signs of terror, nor was it apparently noticed by its dangerous companion. After watching for the rest of the evening, Mr. Bell's friend retired, leaving the rattle-snake and the rat together. He rose early the next morning, and visited the cage: there lay the snake dead, and the rat had supped upon the muscular part of its back. Mr. Bell does not remember at what time of the year this took place, but he expresses his belief that it was not during very hot weather.

The length of time during which a man will linger after being bitten by one of these deadly snakes was manifested in a very distressing case. Some years ago a carpenter came to see a rattle-snake which was publicly shown for money in London. The man endeavoured to excite it, probably to hear its rattle, with his rule, which he dropped into the serpent's cage. As he was trying to recover it the snake bit him in the hand. He was taken to one of the hospitals (St. George's, if we recollect right), and bore up so long that hopes were entertained of his recovery; but his constitution gave way at last, and after many days he fell a victim to the poison. [VIPERINA.]

CROTON, a genus of Plants belonging to the natural order *Euphorbiaceæ*, comprehending a large number of species, many of which have important medical properties. It is distinguished from other genera of its order by monœcious flowers; the males with a 5-parted valvular calyx, 5 petals, 5 glands alternate with the petals, and a definite number of distinct stamens; the females with a 5-parted calyx, no petals, 3 bifid or multifid styles, 5 glands surrounding the ovary, and a tricoccous fruit. The species are extremely diversified in appearance, some being trees, others bushes, others herbaceous plants; many with serrated or lobed leaves, many with entire ones; sometimes covered with hair, sometimes naked; and now with a small compact inflorescence, now having it long and lax. The following are a few of the more remarkable species:—

C. Cascarilla. Leaves lanceolate, acute, quite entire, stalked, downy on the under surface. Stem arborescent. A native of the Bahamas, St. Domingo, and Florida. Fée considers it quite certain that this species is that which furnishes the Cascarilla Bark of commerce; but others ascribe it to *C. Eleutheria*; and Schlede suspects that it may be rather the produce of *C. Pseudo-China*, which he found to be the real Quina Blanca of the apothecaries of Jalapa. Dr. Lindley considers that the true Cascarilla Bark is not yielded by this species but by *C. Eleutheria*.

C. Tiglium. Leaves ovate, smooth, acuminate, serrated. Stem arborescent. Flowers in terminal spikes. Fruit smooth, the size of a hazel-nut. An inhabitant of the Moluccas, Ceylon, and other parts of the East Indies. This plant is at once the most active and dangerous of drastic purgatives; every part—wood, leaves, and fruit—seems to participate equally in the energy. The leaves are so acrid as to inflame the mouth, lips, and fauces of those who merely chew them, bringing on swelling and producing a sensation of burning as far as the anus. The seeds thrown into water intoxicate fish. Ten or twenty fruits bruised with honey have been known to kill a horse by the violent diarrhœa they have produced. Hence the oil obtained from the seeds, which is known by the name of Croton Oil, when used medicinally, has to be administered with extreme care.

Croton Tiglium.

C. lacciferum. Leaves ovate, downy, serrulated, stalked; calyxes downy; flowers in terminal spikes; fruits small and velvety. A native of the East Indies. This species is said to furnish the finest of all the sorts of lac, but scarcely ever to find its way to England. It is very pure, of a bright red, and furnishes a brilliant varnish in Ceylon.

C. Draco, a Mexican plant, with long heart-shaped woolly leaves, with *C. sphærocarpum*, and *C. sanguifluum*, yields, when wounded, a resinous substance of a deep red colour, resembling dragon's blood. Others are merely aromatic. From *C. balsamiferum* the liquor called Eau de Mantes is distilled; *C. aromaticum*, *C. niveum*, *C. fragrans*, and *C. coriaceum* have similar qualities; and *C. thuriferum* exudes a fragrant resin analogous to incense.

The bark of these trees occurs in pieces about a foot long, which are tubular or overlapping, externally covered with a cuticle which easily peels off, so that the liber or bark is often exposed, in which case it feels soft and cork-like. The colour externally is yellowish, ash-gray, or varying to reddish-brown: this last colour is mostly owing to the presence of lichens. The surface is also marked by irregular deep longitudinal furrows. The inner surface is a dirty or rusty-brown colour. Odour faintly aromatic; taste bitter, not unpleasant, and stimulating. No alkaloid has been detected in it; but it possesses much volatile oil. One pound of bark yields one drachm and a half of volatile oil. This bark is sometimes mixed with the cinchona barks, being called Gray Fever-Bark—a substitution in no respect hurtful.

For the medical properties of this genus see CASCARILLA and CROTON OIL, in ARTS AND SC. DIV.

CROTO'PHAGA (Linn.), *Crotophagus* (Browne, Brisson), a genus of Birds placed by Lesson under the third family, Hétéroramphes, of the order Grimpeurs (*Scansores*), Cuvier; *Zygodactyli*, Temminck; Sylvains Zygodactyles, Vieillot.

The bill short, very much compressed, arched, without dentilations, elevated, and surmounted by a vertical and trenchant crest; nostrils basilary, open; fourth and fifth quills longest; tail-feathers long, rounded.

These birds are called Ani and Anno in Guyana and Brazil, and Anno in Paraguay. In Mexico they are named, according to Hernandez, Cacalotototl, and in the Antilles Bouts de Petun, Amangoua, Diables de Savannes, and Perroquets Noirs. In Cayenne their common name is Bouilleur de Canari. Their general colour is black, with more or less of metallic reflections.

A considerable portion of the species are found in America—principally the hot and humid parts, but the south more especially—and the Antilles.

The Anis live in flocks, and are so far from timid that when they see their companions fall before the gun, the survivors fly but a short way, and then again settle. Bushes, the skirts of woods, and the borders of flooded savannahs, are their favourite haunts. Their food consists of small lizards, insects, and seeds. Many pairs are said to use the same nest, built on the branches of trees, and of large dimensions, when considered in relation to the number of couples occupying it, where they lay and hatch their young in concert.

C. Ani is a blackbird with bronzed tints in some lights. Size rather larger than that of the common blackbird; less than that of a jackdaw. Locality, moist savannahs and the neighbourhood of water, in the West India Islands, Carolinas, Brazil, Paraguay, &c. It is the Razor-Billed Blackbird of Jamaica of Catesby, the Savannah Blackbird of the English colonists, and the Great Blackbird of Sloane.

Jamaica Blackbird (*Crotophaga Ani*).

Browne ('Hist. of Jamaica') thus describes it:—"This bird is about the size of a Barbary dove, or something larger, black all over, and splay-footed like a parrot. It has a long square tail, a broad compressed bill, and a short thin tongue: but the beak or upper part of the bill is flatted on the sides, arched and sharp above, and straight at the edges below. They live chiefly upon ticks and other small vermin, and may frequently be seen jumping about all the cows and oxen in the fields; nay, they are often observed to fly on their backs unless they lie down for them, which if much troubled with ticks they generally do when they see the birds about them; but if the beast be heedless they hop once or twice round it, looking it very earnestly in the face every time they pass, as if they seem to know that it was only requisite to be seen to be indulged. They are very noisy birds, and one of the most common sorts in all the pastures of Jamaica. Their flight is low and short."

Sloane thus describes his specimen, under the name of the Great Blackbird:—"This was thirteen inches long from the end of the bill to the end of the tail, and about fifteen inches from the end of one wing to the end of the other, both being extended; the bill was three-quarters of an inch long, and black, the under mandible being straight, the upper of a singular make, distinguishing it from other birds; for it was arched or round, raised high, flat and thin on the upper round edge. The feet have three toes before and one behind (though Marcgrave says otherwise). The legs are two inches long, and black as jet; the middle toe before is one inch and a half long, armed with a pretty sharp claw, and the other toes proportionable. The colour of the feathers all over is black. The stomach of this bird was pretty thick; it was very full of grasshoppers, beetles, &c., disjointed and partly dissolved.

"It haunts the woods on the edges of the savannahs, and is very common, making a loud noise upon the sight of mankind, which alarms all the fowls in their neighbourhood, so that they are very prejudicial to fowlers; but on the other hand, when negroes run from their masters and are pursued by them in the woods to be brought back to their service, these birds, on sight of them as of other men, will make a noise, and direct the pursuers which way they must take to follow their blacks, who otherwise might live always in the remoter inland woods in pleasure and idleness.

"Perhaps this bird may have the toes sometimes two before, at other times two behind."

Sloane's doubt may have arisen from a casual examination of dead specimens. The fact is that the external toe in some scansorial birds can be directed backwards, but not forwards to any extent.

These birds are easily tamed, and may be taught to speak. Their flesh is said to have a bad odour.

CROUGER, a local name for the Prussian or Gibel Carp. [CYPRINIDÆ.]

CROW. [CORVIDÆ.]

CROW-BERRY. [EMPETRUM.]

CROW-FOOT. [RANUNCULUS.]

CROZOPHORA, a genus of Plants belonging to the natural order *Euphorbiaceæ*. The flowers are monœcious. Calyx of male flowers 5-parted; petals 5; stamens 5-10, with unequal connate filaments. Calyx of female flowers 10-parted; petals absent; styles 3-bifid; capsule 3-coccous.

C. tinctoria is a small prostrate hoary annual, with slender cylindrical stems about a foot long; soft, oval, alternate, almost rhomboidal leaves, which are plaited and curled at their edge; small flowers arranged in short clusters, and drooping fruit composed of three blackish rough cells. It is a native of barren places all over the south of Europe, and is cultivated about Montpelier for the sake of the deep purple dye called Tournesole, which it produces. Its properties are acrid, emetic, corrosive, and drastic, like the most virulent Euphorbiaceous Plants.

Crozophora tinctoria.

1, a male flower cut open, showing the stamens; 2, a closed flower; 3, a nearly ripe fruit; 4, 5, different kinds of starry scales, with which all the green parts are covered.

CRUCIAN CARP. [CYPRINIDÆ.]

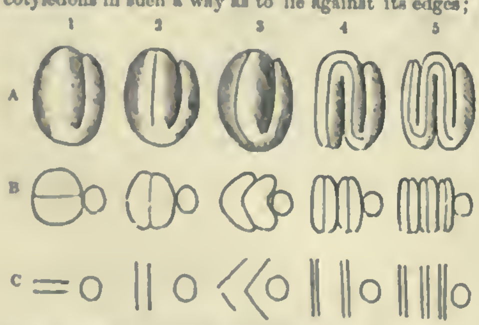
CRUCIFERÆ, *Crucifers*, the Cabbage Tribe, a very extensive and most natural assemblage of Plants, called *Tetradynamia* and *Cruciatæ* by Linnæus, and *Brassicaceæ* by others. It comprehends the Mustard, Cress, Turnip, Cabbage, Scurvy-Grass, Radish, Horse-Radish, and similar plants, having a pungent principle diffused more or less in their sap, and giving them valuable antiscorbutic qualities. All the species have an inflorescence without bracts; a calyx of 4 sepals; 4 petals with long claws, and their blades placed something like the arms of a Maltese cross, whence their name; 6 stamens, 4 of which are longer than the other 2; and a fruit consisting of 2 cells, with a central frame, to which is fitted a pair of deciduous valves, and from the sides of which under the valves is stretched a thin double transparent diaphragm. In each cell are two or more seeds, with an embryo folded upon itself, and destitute of albumen. The form of the fruit is extremely variable: when it is long and slender it is called a Silique, and when short and round a Silicle; hence the two divisions of the *Tetradynamia* of Linnæus into *Siliquosæ* and *Siliculosæ*.

About a couple of thousand species are dispersed over the milder parts of the world, refusing alike to exist beneath the severe cold of the arctic zone and the excessive heats of the tropics. A large proportion consists of inconspicuous and useless weeds; many are objects of beauty from the size and gay colours of their petals; and the names already mentioned show that another part of the order consists of plants useful to man.

Cheiranthus Cheiri.

1, a flower from which the petals have been removed; 2, the stamens; 3, a section of the ovary; 4, a ripe fruit, from which the valves are separating; 5, an embryo.

Owing to the number of the species, and the great resemblance between them, the systematic arrangement of Cruciferous Plants was until late years exceedingly unsatisfactory. It has however been discovered that the embryo presents the most constant character, and that by five modifications of the manner in which it is folded up five precisely limited divisions of the order are secured. The following cut illustrates them. Let A 1 be an embryo with the radicle applied to the cotyledons in such a way as to lie against its edges; then B 1



will be the appearance of such an embryo when cut across, and C 1 will be a sign expressing the mutual positions of the radicle and cotyledons by a circle and two bars: these are *Pleurorhizeæ*. Then *fig.* A 2 will be the same embryo with the radicle applied to the back of the cotyledons; and B 2 and C 2 will give the section and sign of what are called *Notorhizeæ*. When the cotyledons instead of being flat are channeled so as to receive the radicle in a kind of groove, as at A 3, it gives the division *Orthoploceæ*. If the cotyledons are so long as to be doubled twice, A 4, they constitute *Spiroloberæ;* and if, as at A 5, the cotyledons are doubled three times, they indicate the division *Diplecolobeæ*. Upon these distinctions all recent arrangements of *Cruciferæ* have been formed.

The affinities of this order are with *Papaveraceæ*, *Cistaceæ*, *Capparidaceæ*, and *Fumariaceæ*. There are 173 genera and above 1600 species described. It is eminently a European order: 166 species are found in Northern and Middle Europe, and 178 on the northern shore or islands of the Mediterranean; 45 are peculiar to the coast of Africa between Mogadore and Alexandria; 184 to Syria, Asia Minor, Tauria, and Persia; 99 to Siberia; 35 to China, Japan, or India; 76 to Australia and the South Sea Islands; 6 to Mauritius, and the neighbouring islands; 70 to the Cape of Good Hope; 9 to the Canaries or Madeira; 2 to St. Helena; 2 to the West Indies; 41 to South America; 48 to North America; 5 to the islands between North America and Kamtchatka; and 35 are common to various parts of the world. This being their general geographical distribution, it appears that, exclusive of the species that are uncertain or common to several different countries, about 100 are found in the southern hemisphere and about 800 in the northern hemisphere; or 91 in the New and the rest in the Old World. Finally, if we consider them with regard to temperature, we shall find that there are—

In the frigid zone of the northern hemisphere		205
In all the tropics (and chiefly in mountainous regions)		30
In the temperate zone—		
Of the northern hemisphere	548	634
Of the southern hemisphere	86	

Such were the calculations of De Candolle in 1821. Although requiring considerable modification, especially in the Asiatic and North American numbers, which are much too low, they serve to give a general idea of the manner in which this order is dispersed over the globe.

The character of the genera of this order is antiscorbutic and stimulant, combined with an acrid flavour. The officinal species are among the commonest of all plants, and will be found treated of under their respective heads. A large number of genera are natives of Britain. The following is a synopsis of the British genera, according to Babington's 'Manual of British Botany:'—

Sub-Order I. Siliquosæ.

Pod (silique) linear or linear-lanceolate, opening by two valves; dissepiment narrow, but in its breadest diameter.

Tribe I. Arabideæ.

Cotyledons accumbent, parallel to the dissepiment; radicle lateral; seed compressed.

1. *Matthiola.*
2. *Cheiranthus*
3. *Nasturtium.*
4. *Barbarea.*
5. *Turritis.*
6. *Arabis.*
7. *Cardamine.*
8. *Dentaria.*

Tribe II. Sisymbrieæ.

Cotyledons incumbent, contrary to the dissepiment; radicle dorsal seed compressed.

9. *Hesperis.*
10. *Sisymbrium.*
11. *Alliaria.*
12. *Erysimum.*

Tribe III. Brassiceæ.

Cotyledons conduplicate, longitudinally folded in the middle; radicle dorsal within the fold.

13. *Brassica.*
14. *Sinapis.*
15. *Diplotaxis.*

Sub-Order II. Latiseptæ.

Pouch (silicle) short, opening with two valves; dissepiment in its breadest diameter.

Tribe IV. Alyssineæ.

Cotyledons accumbent.

16. *Alyssum.*
17. *Koniga.*
18. *Draba.*
19. *Cochlearia.*
20. *Armoracia.*

Tribe V. Camelineæ.

Cotyledons Incumbent.

21. *Camelina.*

Tribe VI. Velleæ.

Cotyledons conduplicate.

22. *Vella.*

Sub-Order III. ANGUSTISEPTÆ.

Pouch (silicle) short, laterally compressed, opening with two boat-shaped valves, keeled or winged on the back; dissepiment narrow, linear, or lanceolate.

Tribe VII. THLASPIDEÆ.

Cotyledons accumbent.

23. *Thlaspi.*
24. *Hutchinsia.*
25. *Teesdalia.*
26. *Iberis.*

Tribe VIII. LEPIDINEÆ.

Cotyledons incumbent.

27. *Lepidium.*
28. *Capsella.*

Tribe IX. SUBULARIEÆ.

Cotyledons incumbent, long, linear, curved back above their base; cells many-seeded.

29. *Subularia.*

Tribe X. SENEBRIEREÆ.

Cotyledons incumbent, long linear, curved back above their base; cells one-seeded.

30. *Senebriera.*

Sub-Order IV. NUCAMENTACEÆ.

Pouch (silicle) scarcely dehiscent, often 1-celled, owing to the absence of the dissepiment.

Tribe XI. ISATIS.

Cotyledons incumbent.

31. *Isatis.*

Sub-Order V. LOMENTACEÆ.

Silicle or silique dividing transversely in single-seeded cells; the true silique often barren, all the seeds being in the beak.

Tribe XII. CAKILINEÆ.

Cotyledons accumbent.

32. *Cakile.*

Tribe XIII. RAPHANEÆ.

Cotyledons conduplicate.

33. *Crambe.*
34. *Raphanus.*

CRUCIROSTRA. [LOXIADÆ.]

CRUSTA'CEA, Crustacés of the French, Krustenthiere of the Germans, Μαλακόστρακα of Aristotle and the ancient Greeks, a class of Articulated Animals, whose external covering is less solid than that of the majority of Testaceous Mollusks, but much firmer and harder than the skin of the Naked Mollusks; and whose conformation is essentially distinguishable from other classes, especially in the circulating, respiratory, and locomotive organs. The Common Crab [CRAB], the Lobster, and Crayfish [ASTACUS], the Common Shrimp [CRANGONIDÆ], and the Water-Fleas [BRANCHIOPODA], may be taken as types of different sections of this family.

As in many of the Testaceous Mollusks, the skeleton of the *Crustacea* is external. It is made up of the tegumentary envelope, which, in some of the class, always continues soft, but in the greater portion is very firm, forming a shelly case or armour, in which all the soft parts are contained. In the more perfect Crustaceans it is complex. The following description of its component parts is from the pen of M. Milne-Edwards, who, in his 'Histoire Naturelle des Crustacés' (Paris, 1834, &c., 8vo), and in the article 'Crustacea' in the 'Cyclopædia of Anatomy and Physiology (Loudon, 1836, &c.), has given the most complete view of the organisation of this family. Taking the *Brachyura*, or Short-Tailed Crustaceans, as his instance of the more highly developed forms of the class in which the complex structure is exhibited, he thus proceeds, "The integument consists of a corium and an epidermis, with a pigmentary matter of a peculiar nature, destined to communicate to the latter membrane the various colours with which it is ornamented. The corium or dermis, as among the *Vertebrata*, is a thick, spongy, and very vascular membrane; on its inner surface it is intimately connected with a kind of serous membrane, which lines the parietes of the cavities in the *Crustacea* in the same manner as the serous membranes line the internal cavities among the *Vertebrata*; these two membranes, divided in the latter order by the interposition of muscular and bony layers, which cover and protect the great cavities, become closely united when these layers disappear, as they do in the *Crustacea*, in consequence of the important changes that take place in the conformation of the apparatus of locomotion. The corium again, among the *Crustacea*, is completely covered on its outer surface by a membranous envelope unfurnished with blood-vessels, and which must be held in all respects as analogous to the epidermis of the higher animals. It is never found in the properly membranous state, save at the time of the *Crustacea* casting their shell; at this period, it is interposed between the corium and the solid covering ready to be cast off, and has the appearance of a pretty dense and consistent membrane, in spite of its thinness. It forms, as among animals higher in the scale, a kind of inorganic lamina, applied to the surface of the corium, from which it is an exudation. After the fall of the old shell it becomes thicker and very considerably firmer, owing to the deposition or penetration of calcareous molecules within its substance, as well as by the addition of new layers to its inner surface. The degree of hardness finally acquired, however, and the amount of calcareous matter deposited within it, vary considerably; in many members of the class, it remains semicorneous, in a condition very similar to that of the integuments of insects, with which, moreover, it corresponds very closely in point of chemical composition; in the higher crustaceans, again, its composition is very different: thus, whilst chitine in combination with albumen is the principal element in the tegumentary skeleton of some species, this substance scarcely occurs in the proportion of one or two tenths in the carapace of the Decapods, which, on the contrary, contains 60 and even 80 per cent. of phosphate and carbonate of lime, the latter substance particularly occurring in considerably larger proportion than the former. With regard to the pigmentum, it is less a membrane or reticulation than an amorphous matter diffused through the outermost layer of the superficial membrane, being secreted like this by the corium. Alcohol, ether, the acids, and water at 212° Fahr., change it to a red in the greater number of species; but there are some species in which it may be exposed to the action of these different agents without undergoing any perceptible change. The epidermic layer hardened in different degrees is the part which mainly constitutes the tegumentary skeleton of the *Crustacea*. In its nature it is obviously altogether different from that of the internal skeleton of the *Vertebrata*; still its functions are the same, and this physiological resemblance has led naturalists to speak of these two pieces of organic mechanism, so dissimilar in their anatomical relations, under the common name of skeleton. The tegumentary skeleton of the *Crustacea* consists, like the bony skeleton of the *Vertebrata*, of a great number of distinct pieces connected together by means of portions of the epidermic envelope which have not become hardened, in the same way as, among the higher animals, certain bones are connected by cartilages, the ossification of which is only accomplished in extreme old age."

This skeleton, or crustaceous frame-work, consists of a series of rings varying in number, the normal number of the body-segments being twenty-one. Instances of a larger number are rare, and a less number seldom occurs; one or more rings may be apparently absent, but in such cases they will generally be found consolidated as it were. In the embryo the segments are developed in succession from before backwards; the posterior rings therefore are generally absent when the number is defective. Each ring is divisible into two arcs, one upper or dorsal, the other lower or ventral. Each arc may present as many as four elementary pieces. Two of these united in the mesial line form the tergum; the sides of this upper arc are framed of two other portions denominated flanks or epimeral pieces. The lower arc is a counterpart of the upper. Two of the four pieces into which it is divisible constitute the sternum, situated in the mesial line, and are flanked by two episternums. These two arcs do not cohere at their edges, but a space is left for the insertion of the lateral appendages or extremities which correspond with them. (Milne-Edwards; Audouin.)

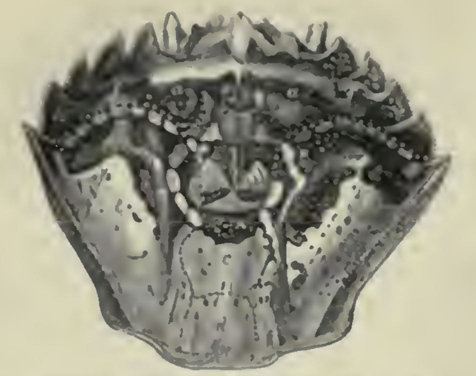
The one-and-twenty rings above mentioned are generally divisible into three sections of seven each, and may be considered as corresponding with the three regions which zoologists have generally consented to recognise in the bodies of the crustaceans, under the denominations of a head, a thorax, and an abdomen; but the student should be on his guard against the false impressions which, as M. Milne-Edwards observes, are likely to arise from these terms, by their leading the mind to liken them to the grand divisions in the *Vertebrata*, which are defined by the same expressions.

The cephalo-thoracic portion and carapace first claim our attention, and the latter acquires its greatest development in the Decapods. "In these animals," says M. Milne-Edwards, "the frame-work of the body does not appear at first sight to consist of more than two portions, the one anterior, formed by the carapace, and representing the cephalic and thoracic segments conjoined; the other posterior formed by the abdomen. In reality, the first fourteen rings of the body are covered by this enormous buckler, and are so intimately conjoined as to have lost all their mobility; the whole of the thoracic segments thus hidden below the carapace are connected with it in their superior parts; they are only joined with one another underneath and laterally; and their tergal parts having, in consequence of this, become useless, are no longer to be found, being in some sort replaced by the great cephalic buckler; thus the whole of these rings, in conformity with this arrangement, are imperfect and open above."

The subjoined cut represents the carapace of a Brachyurous or Short-Tailed Crustacean, and the regions of which it is composed, named after the viscera and organs protected by them.

The succeeding figure represents the carapace of a Macrourous or Long-Tailed Crustacean.

The abdomen is most fully developed in the *Macroura*, or Long-Tailed Crustaceans, in many of which it becomes a very important organ of motion, and in them there is a comparatively small development of the carapace; while in the *Brachyura*, or Short-Tailed Crustaceans,



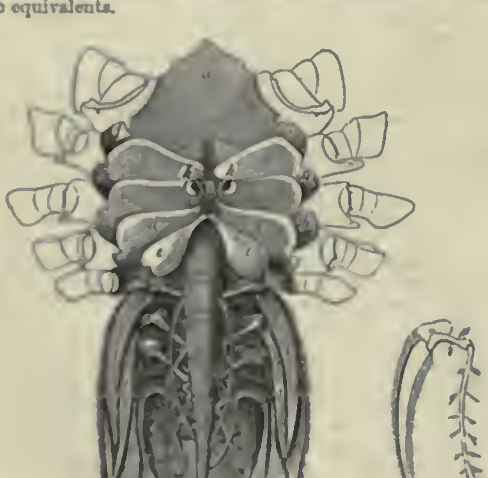
Carapace of *Carcinus mænas* (*Cancer mænas*, Linn.)

a, a, Region of the stomach, or gastric region; *b*, genital region; *c*, cardiac region; *d*, posterior cardiac region; *e, e*, branchial regions; *f, f*, hepatic region.

Carapace of common Crawfish (*Astacus fluviatilis*).

a, Gastric region; *b*, genital region; *c*, cardiac region; *d*, posterior cardiac region; *e, e*, branchial regions.

this rule is reversed, the abdomen being comparatively small, and the great development taking place in the carapace, illustrating the "loi de balancement organique" of M. Geoffroy St. Hilaire. The Common Crab and Common Lobster afford striking examples of this law of organic equivalents.



View of the under side of the female of *Thelphusa fluviatilis*, with the tail or abdomen extended.

a, b, c, d, e, sternal pieces; *f, g, h, i*, latero-sternal pieces; *k, k*, external apertures of the female organs of generation; *l, l, l*, abdominal appendages, or false feet. The detached figure represents one of these appendages removed from the abdomen; the palp marked *m* carries the ova during incubation.

View of the under side of the male of *Thelphusa fluviatilis*, with the male organs. The detached figure represents one of these organs.

On this subject Professor Bell remarks:—" When we consider the almost endless diversity of form under which the species composing this class of animals appear, the astonishing discrepancy which exists in the forms and relative proportions of the different regions of the body, and other parts of their organisation for the performance of offices and functions equally various, and see that all these diversities are produced only by modifications of a typical number of parts, we cannot but be struck by so remarkable and interesting an illustration of the great economical law, as it may be termed, that *the typical structure of any group being given, the different habits of its component species or minor groups are provided for, not by the creation of new organs or the destruction of others, but by the modification in form, structure, or place, of organs typically belonging to the group.*"

One of the necessary consequences of the condition of these animals inclosed in a hard shell is the power they possess of throwing it off. If this were not the case all growth would be stopped, excepting increase of thickness in the shell by a succession of secretions from below. To allow therefore room for the expansion and growth of the body and limbs, a provision for their increase is made by means of moulting, which, as a general rule, is more frequent the younger the animal is, as indeed might be expected. Thus eight moults in the short space of seventeen days have been observed in a young *Daphnia*. [BRANCHIOPODA.] It can be easily observed in the Common Crab. [CANCER.]

In *Astacus fluviatilis*, the moult, or Ecdysis, as this process is called, is preceded by a few days of fasting and sickness, and at that time the carapace becomes loosened from the corium to which it was attached. The corium begins forthwith to secrete a new shell, which is at first soft and membranous, becomes gradually harder and harder, and is at last calcareous. When all connection with the old shell is broken off, and the corium has completely secreted the new membranous envelope, the animal begins to set about freeing itself from the old incumbrance, and becomes very restless, the symptoms of inquietude increasing in proportion as the time for emancipation draws nigh. It rubs its legs one against the other, and finally throws itself on its back. In that situation it begins to shake itself and swell itself out, till it tears the membrane which connects the carapace with the abdomen, and begins to raise the former: then it rests a while. Alternations of agitation and rest succeed each other at intervals of longer or shorter duration, the carapace is completely raised, the head, the eyes, the antennæ, are extricated. The greatest difficulty occurs in freeing the extremities, nor could they be extricated at all did not the old covering split longitudinally: and indeed it frequently happens that the Crawfish leaves a limb or two behind; and is sometimes so fettered, that it perishes from inability to extricate itself. The abdomen is the last division of the body freed, and the whole change generally takes place in half an hour. Four-and-twenty-hours, or two or three days at furthest, are necessary for the conversion of the soft and membranous integument which sheathes the corium or naked body into a firm calcareous case similar to the last, and presenting the same appendages, even to the hairs; although M. Milne-Edwards has stated that these last organs are not formed within the old ones, as supposed by Réaumur, but exist ready-formed in the new envelope, turned in towards the interior like the fingers of a glove turned in upon itself.

Mr. Spence Bate of Plymouth, who has very successfully studied the *Crustacea*, states that he has confirmed the original observation of Réaumur.

M. Milne-Edwards observes that the time occupied in the business of throwing off the shell varies considerably in different species, and that it also depends on atmospheric influences; and this observation applies equally to the number of days required for giving the new tegumentary sheath the consistency of the old shell; and he adds, that in the whole of the species which have been duly watched, especially those found on the French shores, the period which precedes and that which follows the Ecdysis is a period of inquietude and disorder. The muscles are then flaccid, the flesh is soft and watery, and the animals are considered unwholesome and unfit for food. An exception to this remark occurs in the Land-Crabs (*Gecarcinus*), which, according to the testimony of all who have spoken and written on the subject, are never so delicious as during the season of change.

At the period of Ecdysis, rounded flattened calcareous concretions (carbonate of lime), commonly called Oculi Cancrorum, are formed at the sides of the stomach of the common river crawfish. (Prep. 406, Mus. Coll. of Surg.)

Every one has occasionally been struck with the difference of size in the members of crabs and lobsters. One claw of these, and other crustaceans which have the claws, when perfect, nearly equal, is often found of its full volume, while the other is comparatively diminutive; for the animal, upon the limb receiving any injury, has the power of suddenly throwing it off, and the effort does not appear to be attended with pain, though it is frequently made when the system receives a severe shock. [ASTACUS.] The point at which the separation takes place is always in the second articulation, near the basis of the limb, and from the stump, which speedily cicatrises, a new claw buds forth with all the proper articulations, and with an entire though miniature resemblance to the rejected member. This new claw is formed within the old shell and lies folded up until the exuvia are shed, when it appears as a part of the new skeleton. If one of the limbs be severed in any other place than the usual point of separation the stump goes on bleeding, nor does it heal. In such cases the renovating process does not commence until the animal succeeds in separating the remains of the member at the proper point, and this it does by a violent muscular contraction. Some years ago there were some Land-Crabs (*Gecarcinus*) at the Garden of the Zoological Society, and the apparent ease with which they parted with their smaller legs in order to escape from any one who injudiciously took them up by those members was very remarkable. They did not seem to regard the loss at all, and ran away on the remainder of their legs as if nothing had happened. Mr. Harry Goodsir has pointed out that this power of renewing the members in the *Crustacea* depends on a small glandlike body seated at the base of each limb. This body consists of a great number of large nucleated cells, which are interspersed throughout a fibro-gelatinous mass. It is supplied by a vessel and a nerve. Mr. Spence Bate describes the development of the shell as follows:—

"Immediately above the heart, a pulp consisting of nucleated cells, areolar tissue, (and blood vessels?), is formed, extending to the internal surface of the shell, from which it is separated by a layer of pigment which gives colour to the new formation. Towards the base, that is, immediately above the heart, the cells are uniformly large and distinct, while an areolar tissue ramifies throughout the whole. As advance is made from the base, cells of less size mix with them, which increase in number as they diminish, in diameter, until they approach the layer of pigment, immediately beneath which they adapt themselves by mutual pressure into a polygonal form. The pulp extends over the whole periphery of the crab, immediately beneath the shell; the thickness of the pulp decreases with the distance from the centre; and the larger cells become fewer in number, the mass being made of the smaller cells which become the secreting organs of the future shell, which process commences previously to and is completed after the removal of the exuviæ." ('Annals of Nat. Hist.,' vol. vii.)

Of the nature of the organs of locomotion developed by the external skeleton, Milne-Edwards has given the best account:—

"The kind of solid sheath formed by the tegumentary skeleton of the *Crustacea*, and which includes in its interior the whole of the viscera and other soft parts of these animals, is required to be so constructed as not to oppose locomotion; consequently there exist, either between the different rings of the body or the various constituent elements of the limbs, articulations destined to admit of motion to a greater or less extent between these different pieces. The structure of these articulations is of the most simple kind; the moveable piece rests upon that which precedes it by two hinge-like joints, situated at the two extremities of a line perpendicular to the plane in which the motion takes place. In the internal portion of the edge of the moveable piece comprised between the joints there exists a notch of greater or less depth, destined to admit of flexion, whilst on the opposite or external side the same edge generally glides under that of the preceding piece. This kind of articulation, whilst it is the most favourable to precision of movement and to strength, has the disadvantage of admitting motion in one plane only; therefore the whole of the rings of the body, the axis of motion being entirely parallel, cannot move save in a vertical plane; but nature has introduced a kind of corrective of this disadvantage in the structure of the limbs, by changing the directions of the articular axis, whence ensues the possibility of general motions being performed in every direction. Between the two fixed points two opposed empty spaces are observed, left by the rings severally, and destined to admit of the occurrence of motions of flexion and extension. The tegumentary membrane which fills it never becomes incrusted or calcareous, but always continues soft and flexible.

"The tegumentary skeleton supplies the apparatus of locomotion with fixed points of action as well as with the levers necessary to motion. The immediate or active organs of this apparatus are the muscles, the colour of which is white, and the structure of which presents no peculiarity worthy of notice. They are attached to the pieces which they are required to move either immediately or by the intermedium of horny or calcareous tendons, which are implanted upon the edge of the segment to which they belong. To the fixed point they are most commonly attached immediately. Their structure is simple, and each segment in fact, as has already been said, being contrived to move in one fixed and determinate plane, the muscles which communicate motion to it can constitute no more than two systems antagonists to each other, the one acting in the sense of flexion, by which the segment moved is approximated to that which precedes it, the other in the sense of extension, by which the segment is brought into the position most remote from the centre of motion. The muscles that produce these opposite effects, as might have been concluded, are found implanted into the opposite arms of the lever upon which their energy is extended.

"The motions in flexion tend universally to bring the extremities and the different rings towards the ventral aspect of the body; it is consequently upon this aspect that the flexor muscles are inserted, and these are in general the more powerful. On the contrary, and in accordance with the nature of the motion produced, it is upon the superior or dorsal aspect of the segments that the extensor muscles are attached. In the trench the two orders of muscles generally form two distinct layers, the one superficial, the other deep; the former thin and sometimes absent, the second on the contrary very powerful wherever powerful motions are required. The muscles generally extend from the arc above to the one immediately below, passing for the most part from the anterior edge of the upper to the anterior edge of the lower segment. The extent and the direction of the flexion of which any segment is susceptible depend on the size of the interannular spaces above or below the ginglymoid joints; and as these spaces are in general of considerable magnitude on the ventral aspect, whilst the superior arcs are in contact, and can only ride one over another in a greater or less degree, it is only downwards that the body can be bent upon itself, while upwards, or in the sense of extension, it can hardly in general be brought into the horizontal line.

"Thus far what has been said applies more especially to the rings of the body, but the extremities present nothing that is essentially different, either as regards the mode in which the tubular segments are articulated to one another, or as regards the mode in which the muscles are inserted. Each of these indeed having but one kind of motion, and even that very limited in its extent, nature has aided the deficiency, as has been stated, by increasing the number of articulations, by which extent of motion is conferred, and in varying the direction of the articular axes, an arrangement by which the animal obtains the ability of moving in every direction, but at the expense of power, rapidity, and precision in its motions. Each segment of a limb incloses the muscles destined to move that segment which succeeds it, unless it be too short and weak for this end, in which case the muscles themselves have their origin at some point nearer to the medium plane of the body. As a general law the muscles are observed to be more powerful in proportion as they are nearer to the centre, which is to be explained by the fact that each motion they then communicate is transmitted to a larger portion of a limb, to a lever longer in that sense in which it is disadvantageous to the power. Occasionally however the two last segments of a member are converted into a sort of hand, and in this case the penultimate segment sometimes includes a muscular mass, which may surpass in power the same system in the whole of the limb besides. Those muscles that put an extremity generally into motion are attached to the sides of the thoracic cavity, and the apodemata supply them with surfaces of insertion of great extent, and very favourably situated as regards their action. They occupy the double rank of cells formed by these laminæ, but they vary too much in their mode of arrangement to admit of our saying anything generally upon this head. The motion of translation or from place to place, the only kind upon which it seems necessary to say anything here, is effected in two modes, either by the alternate flexion and extension of the trunk, or by the play of the limbs.

"In those *Crustacea* which are formed essentially for swimming, the posterior part of the body is the principal agent in enabling the animal to change its place; but here the motions, instead of being lateral, are vertical; and instead of causing the creature to advance they cause it to recede: it is by bending the abdomen suddenly downwards, and bringing it immediately under the sternum, that it strikes the water, and consequently by darting backwards that the animal makes its way through the liquid. [ASTACUS.] From what has now been said it may be imagined that the *Crustacea* whose conformation is the best adapted for swimming have the abdomen largely developed, and this is in fact what we always observe; the *Amphipoda* and *Decapoda Macroura* are examples; whilst in the walking *Crustacea*, such as the Crabs, the *Caprella*, the *Oniscus*, &c., this portion of the body attains but very insignificant dimensions. In the swimming *Crustacea* the appendages of the penultimate segment of the abdomen also become important organs of locomotion, inasmuch as they for the most part terminate in two broad horizontal plates, which, with the last segment, also become lamelliform, constitute an extensive caudal fin arranged in the manner of a fan. We have already said that the thoracic extremities alone constitute true ambulatory limbs. When destined for swimming only, their segments are lamelliform, and the palp, as well as the stem, contributes to form the kind of oar which each of them then constitutes.

"To conclude, the stemmatous portion of the thoracic extremities, whilst it still preserves the general form which we have assigned it, is modified in some cases to serve for walking as well as swimming, or to aid the animal as an instrument for burrowing with facility, and making a cavity for shelter among the sand. Thus in the Decapods that burrow, the last segment of the tarsus assumes a lanceolated form; and in the swimming *Brachyura*, the same segment, especially of the last pair of extremities (*Matuta*, for example), appears entirely lamellar."

Any one who will take the trouble of going over this excellent description with a common crab and lobster before him, will have a clear idea of the locomotive system in these animals.

We have only further to add, that in a great number of species one or several pairs of the thoracic extremities are modified so as to become instruments of prehension; sometimes it is the last segment of the limb which, acquiring more than usual mobility, bends in such a manner as to form a hook with the preceding segment; sometimes it is this penultimate segment which extends below or by the side of the last, so as to form a kind of immoveable finger with which it is placed in opposition. In the first instance these instruments are denominated subcheliform claws, in the second chelæ simply, or cheliform claws.

Claw (cheliform) of *Thelphusa fluviatilis*.

a, moveable finger; *b*, hand (manus) and immoveable finger; *c*, carpus, or wrist.

Posterior foot of *Thelphusa fluviatilis*.

a, Haunch (hanche); *b*, trochanter; *c*, thigh (femur); *d*, leg; *e*, metatarsus; *f*, tarsus, or nail.

We come now to the organs of digestion. The cheliform or subcheliform claws may be considered as ancillary to this important part of the organisation of the *Crustacea*; and there are other parts, the details of which we proceed to give before we enter at large into this part of the subject.

Jaw-feet (pieds machoires), &c., of *Thelphusa fluviatilis*.

1, right external jaw-foot; A, its internal blade, or tige; *a*, *b*, *c*, *d*, *e*, its various articulations; B, its external blade, or palp; 2, jaw of the fourth pair with its palp; 3, jaw of the third pair with its palp; 4, jaw of the second pair; 5, jaw of the first pair; 6, mandible with its palp; 7, upper lip; 8, tongue (langue) or lower lip.

The maxillary limbs above represented, which constitute the jaws in the Masticating Crustaceans, reach in them their highest development; whilst in the Sucking Crustaceans, which are parasites, and feed on the juices of other animals, a great difference of structure is, as might be expected, observable; certain parts of the apparatus being elongated into a proboscis or tube of longer or shorter dimensions adapted for sucking, and in the interior of which are two slender pointed processes that act as lancets for the purpose of perforation, in lieu of the true mandibles.

The basilar articulations of the anterior thoracic extremities in many species are employed to seize, hold fast, and in a considerable degree comminute, the food; and the most perfect development of this design is manifested in the cheliform claws of the lobsters and crabs, with all their admirable modifications for powerful prehension.

The mouth is a mere opening of the short œsophagus; nor is it furnished with a tongue—the organ so named (langue and languette) is no more than a horny and lamellar process, performing in a degree the functions of a lower lip. The œsophagus, which terminates without any interruption in the stomach, and both parts, with one striking exception in the case of the latter, which we shall presently mention, present nothing remarkable, consisting, as well as the whole of the intestinal canal, of two membranous layers, and presenting a considerable resemblance to the same part of the organisation of the higher animals. The stomach is globular and capacious, occupying much of the area of the cephalic cavity, and consisting of two distinct portions: 1, the cardiac region, surmounting the mouth and œsophagus; 2, the pyloric, placed behind the cardiac region.

Around the pylorus is situated that extraordinary apparatus of hard tubercles or sharp teeth which operate as grinding or tearing organs on the food submitted to the action of this animal mill; and though the different pieces vary considerably in different species, their greater or less development depending upon the nature of the food taken by those species, they may be traced in all the *Brachyura* and *Macroura*. In *Squilla* this masticatory framework is reduced to two half-horny pieces, with rounded projections; and, to make up for this deficiency, a branch of each mandible reaches down to the pyloric orifice.

From the pylorus the intestine proceeds direct to the vent, there being no convolution; but in the higher Crustaceans it is distinguishable into two portions, to which the names of duodenum and rectum have been applied, and which are sometimes, in the lobster for instance, separated by a valve, but more frequently are without defined limits. In the lower Crustaceans the intestine is cylindrical, and offers no difference throughout its whole length from the stomach to the vent, which is always situated in the last ring, and has its orifice closed by muscular fibres which perform the functions of a sphincter.

The liver is largely developed in many of the *Crustacea*, especially in the Decapods; indeed, no one can eat a crab or a lobster without being struck with the large proportions of this viscus, which in those species is considered so delicious. In the Edriophthalmians, on the contrary, it is almost rudimentary, there being in them only three pairs of biliary vessels, much resembling those of insects. The organ, when well developed, consists of two symmetrical portions, generally separated from each other, and composed of a collection of cæcums, which at one of their extremities discharge their secretion into excretory ducts, which being converted by their union into longer and larger vessels, pour the bile ultimately through a double channel into the pylorus. The nature of the whitish fluid secreted by the two, and, as it is said, in some cases three, elongated blind tubular worm-like organs—the first two situated on each side of the pylorus, and the third on the middle of the intestine a short way below them—is not known, nor is its use.

The two green glandular organs placed on each side of the œsophagus are supposed to act in some degree as substitutes for salivary glands.

Much has been written on the subject of the vascular system of the *Crustacea*. The following are the conclusions to which Milne-Edwards and V. Audouin came, after a careful study, as well of the anatomical disposition of the circulating apparatus of the *Crustacea*, as of the progress of the blood through its interior:—

"The circulation of the blood in these animals is accomplished in a manner very similar to what takes place in the *Mollusca*. The blood, pushed forward by the heart, is distributed to every part of the body, from whence it is returned into large sinuses situated at no great distance from the base of the branchiæ; from these sinuses it is sent on to the respiratory apparatus, which it traverses, and from which it finds its way to the heart, to recommence the same circle anew. The heart is consequently aortic and single. The heart is always found in the median line of the body, and lying over the alimentary canal, near the dorsal aspect. Its form is various; in the Decapods it is nearly square, and lies in the middle and superior part of the thorax, being separated from the carapace by tegumentary membranes only, and may be seen in the space included between the two vaults of the flanks. In structure it appears to be composed by the interlacement of numerous muscular fibres, fixed by their extremities to neighbouring parts, and passing to some distance over the aggregate at either end, so that the whole organ brings to mind such a figure as would be formed by the superposition of a number of stars the rays of which do not correspond. In the other orders this general form of the heart varies considerably, from the figure of an oblong square of rather inconsiderable size, as it occurs in the *Decapoda*, to that of a long cylindrical vessel extending through the whole length of the body, as it appears in the *Stomapoda* and the Edriophthalmians. In the former of these it gives origin to six vascular trunks, three of which issue from the anterior edge, and three from the posterior surface;

each of the six openings is closed by a valvular apparatus, which prevents the regurgitation of the blood.

"The first of the three anterior vessels is situated in the median line, and is distributed to the eyes, in consequence of which we have entitled it the ophthalmic artery. Lodged within the substance of the general tegumentary membrane, it continues its course without undergoing any subdivision along the median line through the whole length of the thorax, until, arrived opposite the eyes, it subdivides and terminates in two branches, which penetrate the ocular peduncles. On the two sides are the two antennary arteries. They run obliquely towards the antennæ, sending off numerous branches to the tegumentary membrane, in which they are at first lodged; they then plunge more deeply, sending branches to the stomach and its muscles, and to the organs of generation, between which they insinuate themselves by following the folds of the same membrane which parts them. Lastly, each of these vessels subdivides into two branches, one of which proceeds to the internal and the other to the external antenna.

"Two hepatic arteries arise from the fore part of the inferior surface of the heart, and penetrate the liver, there to be ramified; but they are only found double and distinct from one another so long as the liver is met with divided into two lobes, as it is in the crawfish and lobster.

"From the posterior part of the same surface of the heart there proceeds a large trunk, which, from its importance, might be compared with the aorta. This is unquestionably the vessel which many authors have spoken of as a great vena cava; we have entitled it the sternal artery. It bends forward, giving origin to two abdominal arteries, dips into the sternal canal, distributing branches to the different thoracic rings, as also to the first five cephalic rings, which it passes over in its course. Meeting with the œsophagus, it bifurcates, but still sends branches to the mandibles and the whole of the anterior and inferior parts of the head.

"The bulb presented by the sternal artery at its origin, in the *Macroura*, is the part which Willis characterised as auricle of the heart. As concerns the two abdominal arteries, which may be distinguished into superior and inferior, and which arise from the kind of cross which it forms almost immediately after its exit, they are in precise relationship in point of size with the magnitude and importance of the abdomen itself. In the *Brachyura* they are mere slender twigs; in the *Macroura*, on the contrary, they are capacious stems, and the inferior of the two sends branches to the two posterior pairs of thoracic extremities.

"The disposition of the first three vessels is the same in the *Stomapoda* as in the preceding species; but the great vessel which represents the heart being extended through the whole length of the body, supplies immediately other arterial branches in pairs, and in number equal to those of the rings.

"The blood returns from the different parts of the body by canals, or rather vacuities, among the tissues (for they have no very evident appropriate parietes), which terminate in the venous sinuses situated close to the branchiæ.

"In the short-tailed *Decapoda* we find no more than a double series of these sinuses included within the cells of the planes above the articulation of the extremities. They communicate with one another, and they appear to have no parieties other than laminæ of cellular membrane, of extreme tenuity, which cover the neighbouring parts. Each of them, nevertheless, receives several venous conduits, and gives origin at its superior and external part to a vessel, which, traversing the walls of the planes at the base of the branchiæ, conducts the blood to the latter organs. This is the external or afferent vessel of the branchiæ.

"We find the same lateral venous sinuses in the *Macroura;* but instead of communicating with one another athwart the thoracic septa, as is the case in the *Brachyura*, they all empty themselves into a great median vessel, which is itself a venous sinus, and occupies the sternal canal. In the *Squilla* this sinus is almost the only vessel which serves as a reservoir to the venous blood.

"The blood, after being arterialised in its passage through the capillaries of the branchiæ, is poured into the efferent vessel which runs along the internal surface of each branchia. It enters the thoracic cells in the same manner as the afferent vessel passed out from them, bends upwardly under the vault of the flanks, and thus takes its course towards the heart. It is to this portion of the canal that we have given the name of branchiocardiac vessel."

The anatomical accuracy of the above description is generally admitted; but the physiological deductions of M. Lund differ from those of Messrs. Audouin and Milne-Edwards. He regards the heart as destined to propel, not only the pure blood from the gills, but also an admixture of venous blood which enters the cavity of the heart by four orifices, seated on its dorso-lateral aspects, and distinct from those in which the branchial veins terminate. The French anatomists have objected that these orifices described by Lund are closed by a membrane; but we find them plainly shown, and provided with the valvular apparatus for preventing a reflux of the blood, in a preparation (No. 898 a.) added by Mr. Owen to the Hunterian Series illustrating the same subject in the Museum of the College of Surgeons. John Hunter had long ago arrived at the same conclusions as to the mixed condition of the blood which is sent from the heart, and in a series of elaborate researches on the circulation in the *Crustacea* and Insects, first discovered the diffused state of the venous blood in extensive and irregular venous sinuses; the general disposition of which, in the lobster, is well displayed in the four beautiful plates (15, 16, 17, and 18) illustrative of John Hunter's account of the circulating system of the lobster, in the 'Catalogue of the Physiological Collection,' vol. ii.

With regard to the circulation in the *Amphipoda*, Mr. Spence Bate has pointed out to us that there appear to be no vessels, and that the fluid circulates between the muscular structure.

The vascular system just described is regarded by most authors as a true sanguiferous system, but Professor Agassiz has stated his reasons for believing that the fluid which circulates is not blood but chyle, and that this system must be regarded as chyliferous. ('Ann. Nat. Hist.,' 1851.)

The respiration of the *Crustacea* is carried on generally by means of branchiæ. We say generally, because there are some forms where no special organs have been detected, and where it is presumed that oxygen is obtained from the water through the medium of the external tegument. But where, as in the great mass of these animals, branchial respiration is present, the variety in form and disposition of the apparatus, and in some cases the complexity of it, are very great. Thus, in the *Branchiopoda* the lamellar form of all the thoracic extremities and the two external appendages corresponding to the palp and flabellum present membranous vesicles, flat in shape, highly vascular and soft, whose office is to facilitate the action of the air upon the blood. In the *Amphipoda* and *Læmodipoda* we begin to perceive a gradual departure from this type. In the *Læmodipoda* the vesicular bodies produced by the flabelliform appendage of a certain number of pairs of the thoracic extremities, only perform the functions of branchiæ; and in the *Isopoda* the locomotive extremities cease to act as respiratory organs, the first five pairs of abdominal extremities being exclusively devoted to those duties. The *Stomapoda*, which in some cases are without determinate respiratory organs, in others present an organisation analogous to that of the Decapodous embryo, and again in the *Squillæ* and *Thysanopoda* exhibit a highly-complicated structure of branchiæ, which, though superior even to the highest type in complexity, still fall short of the perfection manifested in that type, inasmuch as the branchiæ float in the water unprotected by any envelope.

M. Milne-Edwards thus reviews the respiratory apparatus in its state of greatest complexity, commencing with it in the embryo, and following it in its progressive development. It should however be recollected that the larvæ of *Astacus fluviatilis* undergo no metamorphosis, and can hardly be regarded as typical of the *Crustacea* :—

"In the earliest periods of embryotic life of the common *Astacus fluviatilis* we discover no trace of branchiæ; but at a somewhat more advanced stage of the incubation, though still before the formation of the heart, these organs begin to appear. They are at first small lamellar appendices of extreme simplicity, attached above the three pairs of maxillary extremities, and representing the flabelliform portions of these limbs. Soon these lamellar appendages elongate and divide into two halves, one internal, lamellar, and triangular, the other external, small, and cylindrical; lastly, upon the surface of this, striæ are observed to appear, which are the rudiments of the branchial filaments. During this interval the thoracic extremities have become developed, and above their bases other branchiæ have made their appearance, presenting in the beginning the form of tubercles, and subsequently that of stilets, smooth and rounded on their surface, but by-and-by becoming covered with a multitude of small tuberculations, which, by their elongation, are gradually converted into branchial filaments similar to the preceding. During this period of the development of the branchiæ, these organs are applied, like the extremities, to the inferior surface of the embryo; but they subsequently rise against the lateral parts of the thorax, become lodged within a cavity situated under the carapace, and thus are no longer visible externally.

"The cavity destined to protect in this manner the branchial apparatus is neither more nor less than an internal fold of the common tegumentary membrane. It shows itself first under the guise of a narrow groove or furrow, which runs along the lateral parts of the thorax, below the edge of the lateral piece of the carapace. This longitudinal furrow is not long of expanding, and becomes consolidated by its superior edge with the internal surface of the carapace, which, by being prolonged inferiorly, constitutes the external wall of a cavity, the opening of which, situated above the base of the extremities, becomes more and more contracted, and ends by being almost entirely closed. The space in this way circumscribed incloses the branchiæ, and constitutes what is called the respiratory cavity of the Decapod Crustaceans.

"From what has just been said, it would appear that the embryo of *Astacus fluviatilis* presents four principal periods with reference to the state of the respiratory apparatus: 1, that which precedes the appearance of this apparatus; 2, that during which the branchiæ are not distinguishable from the flabelliform appendages of the extremities, or in which it consists of simple lamellar or stiliform processes, which appear as mere processes of other organs especially dedicated to locomotion or mastication; 3, that characterised by the transformation of these extremely simple appendages into organs of a complex structure, entirely distinct from the extremities, but still entirely external; 4, and lastly, that during which the branchiæ sink inwards, and become lodged in a cavity especially adapted for their reception, and provided with a particular apparatus destined to renew the water necessary to the maintenance of respiration.

"If we now turn to the examination of the apparatus of respiration in the different groups in which it exhibits important modifications, we shall, in the series of Crustaceans, encounter permanent states analogous to the various phases through which we have just seen the apparatus passing in the most elevated animals of the class. And in fact the first period which we have particularised above in the embryonic life of the Decapod is exhibited in the permanent condition of some inferior Crustaceans, in which not only are there no special organs for respiration, but in which none of the appendices occur with such modifications of structure as would fit them to become substitutes for the branchiæ, in which, consequently, the process of respiration, that is, the aeration of the blood, appears to take place over the surface of the body at large. The greater number of the Haustellate *Crustacea*, of the *Entomostraca* properly so called, of the *Copepoda*, and even of the *Phyllosomata*, appear to belong to this type of organisation."

The branchial character is so inherent in this class, that it is preserved even in certain species that live on the land. The Land-Crab (*Gecarcinus*), for example, would die if long immersed in water; but this, as well as other land Crustaceans, requires a certain degree of moisture to enable the branchiæ to act, and accordingly they never remove far from damp situations.

Much light has been recently thrown on the anatomy of the nervous system and senses in the *Crustacea*.

The principles derived from the study of the gradual evolution of the nervous system in the common Crawfish are—1. The isolated formation of the nervous centres, independently of one another. The ulterior junction of the organs constitutes the law of centripetal development of M. Serres. 2. A tendency to conjunction by a motion transversely. 3. A second motion in the line of the axis of the body, producing a final concentration of a greater or less number of nervous centres, originally independent of each other.

The first of these conditions is well seen in *Talitrus*. On each side of the mesial line in this genus is a chain of ganglions, conjoined by nervous centres of simple construction, flattened, and somewhat lozenge-like in their outline. Thirteen pairs of these correspond to the thirteen segments of the body, the two nuclei of each pair communicating together in the same way that each pair is connected with its antecedent and succeeding pair, by means of medullary cords in the first case, and longitudinal cords in the second. Each of these pairs in all essentials is a counterpart of the other, the cephalic ganglion, which sends branches to the antennæ and eyes, not excepted. In *Phyllosoma* the tendency to centralisation is more obvious, and in *Cymothoë* the union of the medullary nuclei is accomplished, the approximated chains forming a single longitudinal series from head to tail.

In the types, as might be expected, the centralising system is perfected by the actual conjunction of the nuclei. This subject has been fully treated by Rathke, Audouin, Milne-Edwards, and Newport. Mr. Newport's excellent and instructive paper 'On the Nervous System of the *Sphinx ligustri* of Linnæus' ('Phil. Trans.' part ii., 1834), including beautiful illustrations of the nervous system of the Lobster, and showing its identity in principle with that of the Sphinx, may be consulted with advantage.

The conclusion formed by M. Milne-Edwards in his 'Histoire' is, that "the nervous system of the *Crustacea* consists uniformly of medullary nuclei (ganglions), the normal number of which is the same as that of the members or rings of the body, and that all the modifications encountered, whether at different periods of the incubation or in different species of the series, depend especially on the approximation, more or less complete, of these nuclei (an approximation which takes place from the sides towards the median line, as well as in the longitudinal direction), and to an arrest of development occurring in a variable number of the nuclei."

Mr. Newport appears to have been the first who pointed out the double ganglionic chain in the Lobster, as being composed of two orders of fibres, forming distinct and superposed fasciculi or columns, designated by him columns of sensation and of motion.

The highest degree of nervous centralisation is found in *Maia*, according to M. Milne-Edwards, who lays down the following principles, the result of the experiments made by himself and M. Audouin, and his deep and elaborate investigation of the subject:—

"1. The nervous system is the system which entirely presides over the sensations and motions.

"2. The nervous cords are merely the organs of transmission of the sensations and of volition, and it is in the ganglions that the power of perceiving the former and of producing the latter resides. Every organ separated from its nervous centre speedily loses all motion and sensation.

"3. The whole of the ganglions have analogous properties; the faculty of determining motions and receiving sensations exists in each of these organs; and the action of each is by so much the more independent as its development is more isolated. When the ganglionic chain is nearly uniform through its whole length, it may be divided without the action of the apparatus being destroyed in either portion thus isolated,—always understood, that both are of considerable size, because, when a very small portion only is isolated from the rest of the system, this appears too weak, as it were, to continue its functions, so that sensibility and contractility are alike speedily lost. But where one portion of the ganglionic chain has attained a development very superior to that of the rest, its action becomes essential to the integrity of the functions of the whole.

"It must not be imagined, however, from this that sensibility and the faculty of exciting muscular contractions are ever completely concentrated in the cephalic ganglions, and it seems to us calculated to convey a very inaccurate idea of the nature and functions of these ganglions to speak of them under the name of brain, as the generality of writers have been led to do, seduced by certain inconclusive analogies in point of form and position.

"It is nevertheless to be remarked, that in these animals an obscure tendency to the centralisation of the nervous functions is observable in the anterior portion of the ganglionic chain; because if, in the lobster, for instance, it be divided into two portions, as nearly equal as possible, by severing the cords of communication between the ganglions belonging to the first and second thoracic rings, sensibility, and especially mobility, are much more quickly lost in the posterior than in the anterior half, and this disproportion is by so much the more manifest as the division is performed more posteriorly; still there is a great interval between this first indication and the concentration of the faculties of perception and of will in a single organ—the brain—of which every other portion of the nervous system then becomes a mere dependency." ('Cyclo. of Anat. and Phys.')

The sense of sight is possessed by the whole of the class at some period of their lives, and in the great majority the organ is of a highly complicated structure. The parasitic *Crustacea*, which undergo a kind of metamorphosis, possess eyes in the early stage of their existence, though they are subsequently obliterated; but the great mass of Crustaceans are gifted with the power of distinguishing objects through the medium of light from their birth to their death. The different forms presented by the visual apparatus are as follows:—

Smooth or Simple Eyes.—These consist of a smooth rounded transparent cornea, being a modification of the tegumentary membrane, immediately behind which and in contact with it is the crystalline lens, generally spherical, and behind this last and in contact with it is a mass of gelatine, which performs the function of the vitreous humour, and touches the extremity of the optic nerve. A thick deep-coloured pigment envelops the whole, and lines the inner surface of the eye-globe up to the point at which the transparency of the cornea begins. *Limulus* (Molucca Crab, King-Crab) affords an example of this kind of eye. The simple eyes have never been found to exceed two or three in number.

Intermediate Eyes.—*Nebalia*, *Branchipus*, and *Daphnia* present us with the first modification of a visual structure, intermediate as it were between the simple and the compound eyes. In this organisation the cornea is still undivided externally, but a number of small crystalline lenses and vitreous humours, each in its separate pigmentary sac and terminating in immediate contact with the optic nerve, presents an eye consisting of a conjunction of several stemmata or simple eyes under a common cornea—*Apus* [BINOCULUS], besides its pair of simple eyes, has also a posterior compound pair. The second modification, which is to be found in the Edriophthalmians (*Amphithoë*, for instance), brings us still nearer to the truly compound form with distinct facets. Two transparent laminæ form the cornea in these Crustaceans: the external is smooth and undivided, the internal divided into a variable number of hexagonal facets, each with a distinct cornea, which are superposed upon the conical crystalline lens, which is an ingredient in compound eyes properly so called.

Compound Eyes.—The external and internal membranes, the junction of which forms the cornea, present simultaneously the division into facets, each of which forms anteriorly an ocular compartment. Unlike the facets in the eyes of insects, which are always hexagonal, these present various figures in different *Crustacea*. In *Scyllarus*, *Galathea*, the common Crawfish, &c., for example, they are square: in *Pagurus*, *Squilla*, the Crabs, &c., they are hexagons. The crystalline humour that succeeds them immediately, is, according to M. Milne-Edwards, "of a conical form, and is followed by a vitreous humour having the appearance of a gelatinous filament, adhering by its base to the optic nerve." Each of the columns thus formed is moreover lodged within a pigmentary cell, which likewise covers the bulb of the optic nerve. "But the most remarkable circumstance is, that the large cavity, within which the whole of these parallel columns, every one of which is in itself a perfect eye, are contained, is closed posteriorly by a membrane, which appears to be neither more nor less than the middle tegumentary membrane pierced for the passage of the optic nerve, so that the ocular chamber at large results from the separation at a point of the two external layers of the general envelope." . . . . "The most remarkable modification of facetted eyes consists in the presence of a kind of supplementary lens, of a circular shape, and set within the cornea in front of each proper crystalline lens. These small lenticular bodies exist independently, and are perfectly distinct from the small corneal facets. In some cases they might be mistaken (in the *Idoteæ*, for example, where they may be perceived singly, and with their distinct circular forms), and the incautious observer led to conclude that the corneal facets are merely these lenticular bodies so much enlarged that their hexagonal or square forms result from their agglomeration in a point; but there are *Crustacea*, such as the *Callianassæ*, in which these two elements of the external cornea may be perfectly distinguished, the lenticular body being of insignificant dimensions, and occupying the centre of the corneal facet only. In general however the diameter of the lenticular body is equal to that of the corneal facet itself, so that their edges blend. Further, the lenticular bodies are most commonly evolved in the substance of the cornea; but there are cases in which, under favourable circumstances, they may be detached from it. Although the existence of these different modifications must not be considered as being exclusive, inasmuch as there are certain *Crustacea* which exhibit more than one of them at the same time, for instance, stemmata and compound eyes, the latter only are the species of visual organ encountered in the great majority of cases. Their general number is two; but these are occasionally united, so as to form a single mass, and make the animal appear at first sight as if it had but a single eye. This peculiarity of organisation can even be followed in the *Daphniæ* [BRANCHIOPODA], in the embryo of which the eyes are first seen isolated; with the progress of the development however they are observed gradually to approach each other, and finally to become united. Stemmata are always immoveable and sessile; the compound eyes with smooth corneæ however, although in the majority of cases they present the same disposition, now and then occur moveable: sometimes they are supported by a pedicle, moveable in like manner and provided with special muscles. The eyes with facets present the same modifications, and even supply important characters in classifying these animals: thus in the *Edriophthalmia* the eyes are always immoveable and sessile, whilst in the *Decapoda* and *Stomapoda* they are supported upon moveable stems of very various lengths, and which every consideration leads us to view as limbs or appendages of the first cephalic ring. It sometimes even happens that in these animals, between the outer edge of the carapace and the base of the antennæ, there occurs a furrow or cavity, within which the eyes may be withdrawn or laid flat, so as to be out of the way of injury; this groove or cavity is generally spoken of under the name of the orbit." ('Cycl. of Anat. and Phys.')

Absence of Eyes.—Mr. Westwood has recently made known through the Linnæan Society a form of *Edriophthalmia* inhabiting a deep well, a species in which there is no external appearance of eyes whatever. Mr. Newport has however, with his accustomed accuracy in dissection, pointed out that even in this case a rudimentary visual organ exists underneath the cephalic crust.

In some of the forms (*Maia*, for instance) there is a fringe of hairs on the inner side of the orbit, so placed as to perform the office of a brush in wiping the eye when brought into contact with it.

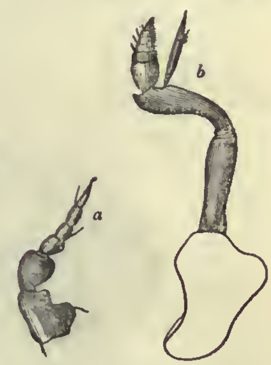
With regard to hearing, a cavity full of fluid, supplied with a nerve fitted for the perception of impulses of sound, forms the basis of the auditory system in the *Crustacea*. This apparatus appears to be assisted by certain organs, elastic membranes, and rigid stems, for instance, organised so as to vibrate under the action of sonorous undulations, or to assist such vibrations. The long rigid stem formed by the antennæ of the second pair is said to assist in this function, and, according to the highly interesting experiments of M. Savart, the addition of such a rigid stem renders certain vibrations appreciable; but in some instances no such stem exists. In many of the forms (*Maia*, for instance) there is an ossiculum auditus.

In the Museum of the College of Surgeons (Gallery, No. 1559 A) is a Hermit Crab (*Pagurus Miles*, Oliv.), prepared by Mr. Owen to show the organ of hearing, which is composed of a simple vestibular cavity situated at the under part of the basal joint of the external antennæ. The cavity is surrounded by a dense crustaceous substance, except at the internal opening, where the auditory filament of the antennal nerve penetrates it, and at the opposite side, where an elliptical opening or fenestra is left, which is closed by the acoustic membrane: the membranes of sound affect this membrane, and are transmitted to the nerve, which is exposed on the left side. (Owen, 'Cat. of Physiolog.,' series, vol. iii. part 1.)

Every lobster-pot that is baited on our coasts affords evidence that the Crustaceans are endued with the sense of smelling, but where the organ is seated is doubtful. M. de Blainville placed it in the antennæ, where it certainly does not reside, according to M. Milne-Edwards, who further states that the opinion of M. Rosenthal, who ascribes the function to a cavity which he discovered at the base of the first pair of antennæ, requires to be supported by direct experiment.

Though the *Crustacea* have no true tongue, their selection of food and the preference exercised by them, show that they are gifted with the sense of taste or a sense analogous to it. The seat of the faculty is most probably that portion of the tegumentary membrane that lines the inside of the mouth and œsophagus.

The more or less calcareous crust with which the *Crustacea* are covered forms a medium not calculated to convey external impressions of any delicacy. "Nevertheless," says M. Milne-Edwards, "in front of the head there are certain special organs which all the observations I have had an opportunity of making upon the organisation of these animals lead me to regard as parts more particularly destined to be the seat of the sense of touch. These organs are the antennæ—those slender filaments possessed of a great degree of flexibility, of motility, and of sensibility. M. de Blainville was led to regard these organs as the seat of the sense of smell; but direct and conclusive experiment has satisfied us that the destruction of the antennæ has no influence whatever on the exercise of the sense of smell: and we are on the same grounds induced to believe them destined to the exercise of the sense of touch of considerable delicacy, unless we would imagine them as the instruments of some quite peculiar sense, the existence of which would be purely hypothetical. The number and disposition of these organs vary extremely. Some of the Crustaceans at the very bottom of the series are wholly without antennæ, or are furnished with them in a merely rudimentary state. Some species have no more than a single pair; the normal number however is two pairs. In speaking of the tegumentary skeleton we have said to which of the rings these appendages belong; we shall only say further here that they may be inserted on the superior or inferior surface of the head according to the respective development of the different pieces of which this segment is composed. They do not differ less widely in their form and composition, and under this double point of view present modifications analogous to those which we have specified as occurring in the extremities."



a, right external antenna of *Thelphusa fluviatilis*; *b*, left antenna of the same. Desmarest.

As a rule the sexual organs are separate in the *Crustacea*, that is, they never co-exist in the same individual, and the reproduction is oviparous. Milne-Edwards has however described a crab in which the organs were male on one side and female on the other. Mr. Spence Bate also informs us that he has in his possession a specimen of *Corystes* in which all the characteristics are female but with male organs. The celebrated hermaphrodite lobster also ('Phil. Trans.,' 1730, p. 290) presented a different sexual organ on each side, and both the male and female portion were complete. In the more perfect *Crustacea* the analogy between the male and female organs is so great as frequently to deceive the observer at first sight.

In the male organs of the Common Crab the testis is grape-like, the cluster consisting of four principal lobes formed of numerous worm-like delicate canals convoluted into pellets. The first portion is placed in the front of the thorax, and terminated in a large coiled-up vessel situated on the side of the stomach; behind, and connected with it, is the deferent vessel, a convoluted canal of some size and of a milky colour. It is twisted about the thorax, and at last penetrates the cell of the last pair of limbs, opening outwardly on the basilar piece, and again passes into the styliform organs, which are true intromittent organs. The intercourse of the sexes only takes place during the time that the female is moulting.

"The female reproductive apparatus of the *Crustacea*," says Milne-Edwards, "in the highest state of complication consists of an ovary, an oviduct, and copulatory pouches. The ovaries in the *Decapoda brachyura* resemble four cylindrical tubes placed longitudinally in the thorax, and divided into two symmetrical pairs, each opening into a distinct oviduct, yet communicating with one another by a transverse canal, and by the intimate union of the two posterior tubes in a portion of their length. The oviducts as well as the ovaries are of a whitish colour; they are short, and become united in their course to a kind of sac, the neck of which extends to the exterior of the animal's body; there is one of these on each side, and they are known by the name of the copulatory pouches. It is into these reservoirs that the male pours the spermatozoa, which are simple round cells, and are applied to the ova as they pass in succession along and out of the oviducts. These, after a course which is never long, terminate at the vulvæ—openings formed in the sternal pieces of the segment which supports the third pair of ambulatory extremities.

"The *Anomoura* and *Macroura* have no copulatory pouches, and their vulvæ are situated on the basilar joint of the ambulatory extremities of the third pair. The mode in which fecundation is accomplished in these genera is consequently much less apparent than in the *Brachyura*. Many writers are of opinion that this operation takes place in the interior of the ovaries, a process that appears by no means feasible on account of the inequality of development of the ova, which is such that the last of them are not in being even long after the first have been expelled.

"The female Crustacean does not abandon her eggs after their extrusion. Those of the Decapods preserve them under their abdomen by means of the abdominal extremities modified in their structure. The *Edriophthalmia*, again, keep them under their thorax by means of the flabelliform appendages of the extremities belonging to the region; whilst the inferior genera, such as the *Entomostraca*, &c., have suspended to the external orifices either horny tubes or a pair of membranous sacs which contain and transport them from place to place. These varieties in the accessory organs of generation are in many cases sufficient to distinguish the sexes; thus, among the *Decapoda brachyura*, the females are known at a glance by their wider abdomen, which is sometimes of such dimensions as to cover the whole sternum."

The following cuts will convey some idea of the relative position of the parts in the carapace.

Common Shore-Crab (*Carcinus mænas*), open.

a, a, a, a, a, stomach; *b, b*, genital organs; *c*, heart; *d, d*, branchiæ; *e, f, f*, liver.

Fresh-Water Cray-Fish (*Astacus fluviatilis*), open.

a, a, a, a, stomach; *b*, genital organs; *c*, heart; *d, d, d, d, d*, liver; *e, e*, branchiæ; *f, f*, muscles of the mandibles.

At one time it was supposed that the young of the *Crustacea* underwent no change after being hatched from the ova, and this was formerly given as a distinction between the Insects and *Crustacea*. We now know however that those anomalous forms of animal life known by the name of *Zoea*, and referred by Bosc and others to the Entomostracous *Crustacea*, are truly the young of the higher forms of *Crustacea* undergoing metamorphosis. [BRANCHIOPODA.] The facts of this process were first made out by Mr. V. Thompson in the year 1823, and subsequently the instances in which it has been observed are so numerous that there can be no doubt that metamorphosis takes place in all the Marine Decapodous *Crustacea*. In the various forms of *Macroura*, the metamorphosis is less decided than in the *Brachyura*; and in the Fresh-Water Cray-Fish (*Astacus fluviatilis*) no change takes place at all. These have led some observers to doubt the correctness of Mr. Thompson's conclusions. One of the last and most important series of investigations conducted on this subject was by Mr. R. Q. Couch, of Penzance, Cornwall, who, dissatisfied with the uncertainty and contradiction of former testimony, resolved to investigate the matter for himself. He observed the metamorphosis to occur in the following genera:—*Cancer*, *Zantho*, *Pilumnus*, *Carcinus*, *Portunus*, *Maia*, *Galathea*, *Homarus*, and *Palinurus*. The details of Mr. Couch's observations were published in the 'Proceedings of the Cornwall Polytechnic Society' for 1843.

Professor Bell says, "Eliminating, therefore, this exceptional case (that of *Astacus fluviatilis*), it will be found that the fact of a metamorphosis has been demonstrated with more or less success in no less than seventeen genera of the Brachyurous order of the *Decapoda*, in which order the phenomenon is most decided and obvious, belonging to the families *Leptopodiadæ*, *Maiadæ*, *Canceridæ*, *Portunidæ*, *Pinnotheridæ*, *Grapsidæ*, *Gecarcinidæ*. In the Anomourous order it has been shown in the genera *Pagurus*, *Porcellana*, and *Galathea*, and amongst the *Macroura* in *Homarus*, *Palinurus*, *Palæmon*, and *Crangon*."

The following is Mr. Couch's account of the changes which take place in the Common Shore-Crab (*Carcinus mænas*). Having procured some specimens of the Crab laden with ripe ova, he says—"These were transferred to captivity, placed in separate basins, and supplied with sea-water, and in about sixteen hours I had the gratification of finding large numbers of the creatures alluded to above swimming about with all the activity of young life. There could be but little doubt that these creatures were the young of the captive crabs. In order however to secure accuracy of result, one of the crabs was removed to another vessel and supplied with filtered water, that all insects might be removed; but in about an hour the same creatures were observed swimming about as before. To render the matter if possible still more certain, some of the ova were opened, and the embryos extracted, but shortly afterwards I had the pleasure of witnessing beneath the microscope the natural bursting and escape of one precisely similar in form to those found so abundantly in the water. Thus then there is no doubt that these grotesque-looking creatures are the young of the *Carcinus mænas;* but how different they are from the adult need hardly be pointed out. When they first escape they rarely exceed half a line in length. The body is ovoid, the dorsal shield large and inflated; on its upper edge and about the middle is a long spine, curved posteriorly, and rather longer than the diameter of the body, though it varies in length in different specimens; it is hollow, and the blood may be seen circulating through it. The upper portion of the body is sap-green and the lower semitransparent. The eyes are large, sessile, and situated in front, and the circumference of the pupil marked with radiating lines. The lower margin of the shield is waved, and at its posterior and lateral margin is a pair of natatory feet. The tail is extended longer than the diameter of the shield, and is composed of five equal annulations besides the terminal one; its extremity is forked, and the external angles long, slender, pointed, and attached to the last annulation by joints. Between the external angles, and on each side of the median line, are three lesser spines, also attached to the last ring by joints. Between the eyes and from near the edge of the shield hangs a long stout and somewhat compressed appendage, which as the animal moves is reflexed posteriorly between the claws. Under each eye there is also another appendage, shorter, and slightly more compressed. The claws are in three pairs; each is composed of three joints, and terminates in four long slender hair-like appendages. These claws are generally bent on the body, but stand in relief from it. If the animal be viewed in front the lower margin of the dorsal shield will be found to be waved into three semicircular festoons, the two external of which are occupied by the eyes, and between which the middle one intervenes; the general direction of the claws will be seen to be at right angles to the body. As the young lies inclosed within the membranes of the egg, the claws are folded on each other, and the tail is flexed on them so far as the margin of the shield; and if long enough is reflected over the front of the shield between the eyes. The dorsal spine is bent backwards, and lies in contact with the dorsal shield; for the young, when it escapes from the egg, is quite soft, but it rapidly hardens and solidifies by the deposition of calcareous matter in what may be called its skin. The progress of this solidification may be very beautifully observed by watching the circulation in the dorsal spine. When the creature has just effected its liberation from the egg, the blood globules may be seen ascending to the apex, but as the consolidation advances the circulation becomes more and more limited in its extent, and is finally confined to the base. These minute creatures, in this early state of their existence, are natatory and wonderfully active. They are continually swimming from one part of the vessel to the other, and when observed free in their native pools, if possible even more active than when in confinement. Their swimming is produced by flexions and extensions of the tail, and by repeated beating motions of their claws; this, together with their grotesque-looking forms, gives them a most extraordinary appearance when under examination. As the shell becomes more solid they get less active, and return to the sand at the bottom of the vessel to cast their shells, and acquire a new form. They are exceedingly delicate, and require great care and attention to convey them through the first stage, for unless the water be supplied very frequently and in great abundance they soon die. The second form of transmutation is equally as remarkable as the first, and quite as distinct from the adult animal. In the species now under consideration this second transformation is marked by the disappearance of the dorsal spine; the shield becomes flatter and more depressed: the anterior portion more horizontal and pointed, the three festoons having disappeared. The eyes, from being sessile, are now elevated on foot-stalks; the infra-orbital appendages become apparently converted into antennæ. The claws undergo an entire revolution; the first pair become stouter than the others, and are armed with a pair of nippers, the others being simple, but the posterior pair are branched near the base, and one of the branches ends in a bushy tuft. The tail is greatly diminished in its relative size and proportions, and is sometimes partially bent under the body, but is more commonly extended. This form is as natatory as the first. They are frequently found congregating around floating seaweed, the buoys and strings of the crab-pot marks, and other floating substances, both near the shore and in deep water. Their general form somewhat resembles a *Galathea*."

Subsequently to this second change a third takes place, in which the animal loses its tail, and becomes more like to the form it assumes in adult age. In the various species different forms are assumed, but they can all be referred to departures from the typical form of the family. On this point the following observations of Mr. Couch are very interesting:—

"So far as my observation has extended, it appears probable that the metamorphosis of the young in their progress to adult growth is not universal in all Crustaceans; but, on the contrary, that the families in which the eyes are always sessile in their adult growth, and which do not exuviate or voluntarily throw off their limbs, are in the habit of producing their young perfectly formed: and an opportunity that has occurred to me of observing the process of early development in the common lobster will tend to establish the existence of a law of nature as applicable not only to it, but probably also to all the genera of this extensive family or class, that is, the Long-Tailed *Crustacea*; which law is, that the greatest extent of metamorphosis is in those genera which are of the highest rank in the series, that is, the Short-Tailed, or Crabs, that even at their birth the Long-Tailed genera, as the Lobster, approach more closely to the ultimate size of the parent; and, what is still more extraordinary than all beside, that so long as the lobster in particular retains the eyes sessile, the progress of development and growth is conformed to what is the perpetual mode of growth of the permanently sessile-eyed races; and it is only when the crust has become fully extended and hardened, and thus the exuviation is rendered necessary, that the eyes become elevated on foot-stalks, and the adult form and habit are completely established."

With regard to the arrangement of the *Crustacea*, almost every writer on this class of animals has embodied his own views in their classification. Among the principal zoologists who have written on the subject, the names of Cuvier, Desmarest, Latreille, and Leach will, with many others, occur to the observer. We select the arrangement of M. Milne-Edwards, because it is founded on anatomical investigation, and on actual experiment made in a great many instances by himself and M. Audouin. He makes the *Crustacea* to consist of two great divisions.

1st. Those which have the mouth furnished with a certain number of organs destined in an especial manner to the prehension or division of the food.

2nd. Those which have the mouth unfurnished with special prehensile or masticatory organs, but surrounded by ambulatory extremities, the bases of which perform the part of jaws. We shall take this second division first, because it contains but one order, namely, the *Xyphosura*. Example, *Limulus*.

But it is to the first division that the great mass of the Crustaceans belong, and these are subdivided into two great groups.

1st. The *Maxillosa*, or *Mandibulata*, which possess a mouth armed with jaws, &c.

2nd. The *Edentata*, or *Haustellata*, whose mouth is prolonged in the shape of a sucker.

I. Maxillosa.

The *Maxillosa* are separated into four great sections:—

1. *Podophthalmia.*

These almost always possess true branchiæ; pedunculated and moveable eyes; feet or extremities vergiform, partly prehensile, partly ambulatory; and a thorax covered by a carapace.

The *Podophthalmia* contain two orders, the *Decapoda* and *Stomapoda*.

1. The *Decapoda*, whose branchiæ are fixed to the sides of the thorax, and are inclosed in special respiratory cavities. The oral apparatus is composed of six pairs of members. There are five pairs of thoracic extremities, which are generally ambulatory. The *Decapoda* are divided into 1st, the *Brachyura* (*Cancer, Portunus, Grapsus, Podophthalmis, Thelphusa, Gecarcinus, Ocypode, Pinnotheres, Maia, Leucosia, Dorype*, &c.); 2nd, the *Anomoura* (*Dromia, Ranina, Pagurus, Hippa, Remipes, Brigus*, &c.); 3rd, the *Macroura* (*Astacus, Scyllarus, Palæmon, Palinurus, Penæus*, &c.).

2. *Stomapoda*, whose branchiæ are external; sometimes rudimentary, or none. Oral apparatus composed in general of three pairs of members. Thoracic extremities prehensile, or for swimming; generally six or eight pairs. (*Mysis, Phyllosoma, Squilla, Thysanopodes, Alima, Cynthia*, &c.).

2. *Edriophthalmia.*

True branchiæ none, but replaced by certain portions of the extremities modified for this in their structure; eyes sessile; thoracic extremities ambulatory, almost always consisting of seven pairs; no carapace. The *Edriophthalmia* contain three orders, namely, the *Amphipoda*, the *Læmodipoda*, and the *Isopoda*.

1. *Amphipoda*.—These have the flabella of the thoracic extremities vesicular, and subserving respiration. The abdomen is very much developed, subserving locomotion, and is furnished with six pairs of limbs, the first three of which differ in form and use from the last three. (*Grammarus, Talitra, Hyperia, Phronima*, &c.)

2. *Læmodipoda*.—Abdomen rudimentary. Flabella of the thoracic extremities vesicular, and subserving respiration. (*Proto, Caprella, Cyanus*, &c.)

3. *Isopoda*.—Abdominal extremities well developed; the first five pairs lamellar, and subserving respiration. Abdomen well developed. (*Idotea, Spheroma, Cymothoa, Iona, Bopyrus*, &c.)

3. *Branchiopoda.*

No true branchiæ, but thoracic extremities lamellar, membranous, and so formed as to be subservient to respiration. The *Branchiopoda* contain two orders, *Phyllopoda* and *Cladocera*.

1. *Phyllopoda*.—No bivalve shell-like covering. Extremities natatory, and in considerable numbers (from 8 to 22). (*Limnadia, Chirocephalus, Nebalia*, &c.)

2. *Cladocera*.—Carapace in form of a bivalve-shell. Thoracic members five pairs. (*Daphnia*, &c.)

4. *Entomostraca.*

No branchiæ nor any modification of organ apparent to supply the place of these. Eyes sessile, and commonly united into a single mass. The *Entomostraca* contain two orders, namely, the *Copepoda* and *Ostrapoda*.

1. *Copepoda*.—Body divided into distinct rings, neither carapace nor valvular envelope. Thoracic and oral members in considerable numbers. (*Cyclops, Pontia*, &c.)

2. *Ostrapoda*.—Body without very evident annular divisions, and entirely inclosed under a large dorsal shield having the form of a bivalve-shell. Extremities in very small number. (*Cypris*, &c.)

II. Edentata.

The *Edentata* contain three orders, namely, the *Araneiformes*, the *Siphonostomata*, and the *Lernæiformes*.

1. *Araneiformes*.—Extremities rod-like, long, adapted for walking. (*Pycnogonon, Nymphon*.)

2. *Siphonostomata*.—Extremities not adapted for walking; partly lamellar, partly prehensile. (*Caligus, Dichelestion, Nicothoa*, &c.)

3. *Lernæiformes*.—Extremities rudimentary, body presenting anormal forms. (*Lernæa*, &c.)

Fossil Crustacea.

Various forms of *Crustacea* have been found throughout the whole series of fossiliferous rocks. Although their shells are not so well calculated to resist decomposition as those of the *Mollusca*, and even the *Echinodermata*, yet a considerable number of species have been recorded, especially of the smaller forms. Bronn, in his list of extinct and recent species of the families of animals, gives the following as the result amongst the *Crustacea*:—

	Extinct.	Recent.
Entomostraca	563	143
Malacostraca	244	541

These numbers are probably higher for the extinct and lower for the recent than the present state of our knowledge would warrant.

One of the most interesting groups of extinct *Crustacea*, are those found in the Silurian Rocks, and which from their most prevalent forms may be called Trilobitic. [Chirocephalus; Trilobites.] The species in this formation are more abundant than at any subsequent period, and present greater departures from the types of existing *Crustacea*.

In the Devonian Rocks the *Crustacea* are represented also by Trilobitic forms, some of which, as *Brontes*, are characteristic and remarkable. This fossil which was at first supposed to be a fish, has been referred by Agassiz to the *Crustacea*. It was not unlike a lobster in shape, but was four feet in length. Its claws were of gigantic size. The shield was sculptured with delicate markings, looking like scales. The tail was continuous, and so large that a lobster of ordinary size might stretch its entire length on it.

The Carboniferous group of Rocks presents us with a considerable number of species of *Crustacea*, but they principally belong to the groups of smaller forms referred to the Entomostracous *Crustacea*. [Entomostraca.] We have however, in certain forms, as in those species which have been referred to *Apus, Asaphus, Daphnia, Cypris*, and *Limulus*, approaches to the forms which exist at the present day. Of the Ostracodous *Crustacea* Professor M'Coy has figured, and has described twenty-two species from the Carboniferous Limestone of Ireland; M. de Koninck six species in Belgium. The *Ostracoda* described in the Carboniferous and Silurian Rocks amount to about thirty-seven species.

The Permian system, embracing the Magnesian Limestone Formation of England, affords the remains of no other Crustacean but those belonging to the *Entomostraca* or *Ostracoda*.

In the Oolitic Rocks the species of *Crustacea* are not numerous, but the forms so closely resemble those more common at the present time as to afford some difficulty in distinguishing them. The specimens discovered in British rocks have all been referred to the genus *Astacus*, of which Professor Tennant gives four species—*A. leptomanus A. mucronatus, A. scabrosus, A. rostratus*. The Lithographic Limestone of

Solenhofen, affords several examples of the *Crustacea* of this formation. It contains species of *Limulus*, and also of a genus *Ergon* allied to the recent genus *Astacus*.

In the Chalk, specimens of *Crustacea* are found representing both the lobster and the crab. The following list of species is given by Tennant in his 'British Fossils:'—*Astacus Leachii, A. longimanus, A. Sussexianus, Orithrya Bechei, Pagurus Faujasii, Scyllarus Mantellii.*

In the Tertiary beds the remains of *Crustacea* are not very numerous, but their forms are many of them identical with those now existing. Many forms remain yet to be discovered, especially among the minute *Entomostraca* [CYTHERE], of which only a few have yet been described.

(Bell, *History of the British Stalk-Eyed Crustacea;* Owen, *Lectures on Comparative Anatomy;* R. Jones, *Outlines of Animal Kingdom; Cyclopædia of Anatomy and Physiology*, article *Crustacea;* Spence Bate, in *Annals of Natural History;* Milne-Edwards, *Histoire Naturelle des Crustacées;* Rathke, *Untersuchungen über die Bildung und Entwickelung des Fluss-Krebses;* J. V. Thompson, *Metamorphoses of Crustacea;* Rupert Jones, *Monograph of the Entomostraca in the Cretaceous Formations of England*—Pal. Soc.; W. King, *Monograph of Permian Fossils*—Pal. Soc.; Baird, *History of British Entomostraca*—Ray Soc.; Burmeister, *The Organisation of Trilobites*—Ray Soc.)

CRYOLITE, a species of Mineral, a fluate of soda and alumina. It is of a white colour, or reddish, or yellowish-brown, and its streak is white. It occurs in crystalline masses, but its primary form has not been observed; its cleavage is parallel to the terminal and lateral planes of a rectangular prism. Its specific gravity is from 2·94 to 2·963. It is not so hard as fluor-spar, is translucent, and by immersion in water becomes transparent. It fuses by the blow-pipe into a transparent globule, which becomes opaque on cooling.

It is found at Arksut-fiord, in West Greenland. According to the analysis of Vauquelin it consists of—

Fluoric Acid and Water	47
Soda	32
Alumina	21
	——100

CRYPTOCE'PHALUS (Geoffroy), a genus of Coleopterous Insects of the section *Cyclica* and family *Chrysomelidæ*. It is known by the antennæ being filiform, nearly as long as the body; palpi with the joints nearly of equal thickness; head deeply inserted into the thorax, small and vertical; thorax nearly as broad as the elytra; body short and cylindrical.

Upwards of twenty species of this genus are found in this country. The most abundant species is *Cryptocephalus sericeus*. This little beetle is of a brilliant golden-green colour, and about a quarter of an inch in length; it is found during the month of July in the flowers of the *Hieracium* and similar plants.

Cryptocephalus Lineola is about the same size as the last, and is found on oak-trees, hazels, &c.; it is black and glossy; the elytra are red, and have an oblong dash in the middle, and the suture and outer margin black.

CRYPTOCONCHUS, a name given by some zoologists to those *Chitonidæ* whose shelly plates are entirely hidden by the investing border. [CHITONIDÆ.]

CRYPTODIBRANCHIATA, De Blainville's name for the Cephalopodous *Mollusca*. [CEPHALOPODA.]

CRYPTOGA'MIA, the twenty-fourth class of the Linnæan System of Plants. It includes all those genera the flowers of which are either altogether absent, or formed upon a plan different from that of ordinary plants. Ferns, Mosses, Lichens, *Algæ*, *Fungi*, with their immediate allies, form the class, which is the same as the Acotyledons of Jussieu and the *Cellulares* of De Candolle. It is often employed to distinguish the Flowerless from the Flowering Plants, which are thence called *Phanerogamia*. [LICHENS; LYCOPODIACEÆ; ALGÆ; FUNGI; DIATOMACEÆ; ACROGENS; DESMIDEÆ.]

CRYPTOLITE. [CERIUM.]

CRYPTONYX. [TETRAONIDÆ.]

CRYPTO'PHAGUS (Herbst), a genus of Coleopterous Insects of the family *Engidæ*. They are minute beetles, which are found in *Fungi* and in flowers, and some of the species are common in damp cellars.

The *Cryptophagi* are seldom more than an eighth of an inch in length, generally of a pale brown colour, and more or less pubescent. They have the antennæ rather thick and 11-jointed; the basal joint is thicker than the seven following, and the three apical joints form an elongated knob; the terminal joint is somewhat conical, and the two preceding joints are cup-shaped; the head is nearly triangular, inserted into the thorax as far back as the eyes; the thorax is nearly square, and the lateral margins are more or less denticulated; they usually exhibit an obtuse tooth-like process in the middle; the elytra are elongate; the sides are generally straight and parallel, or nearly so, and the apex is rounded.

About sixteen species have been found in this country. *Cryptophagus bituberculatus* is sometimes abundant in puff-balls, and probably inhabits other *Fungi*.

CRYPTOPROCTA. [VIVERRIDÆ.]

CRYPTORHY'NCHIDES (Schönherr), a family of Coleopterous Insects belonging to the section *Rhynchophora*, the species of which are chiefly distinguished by their possessing a groove in the chest into which the rostrum is received when at rest.

This family contains upwards of twenty genera, of which the genus *Cryptorhynchus* may be considered as the type. The characters of this genus are:—Antennæ 12-jointed, short, funiculus 7-jointed, the first joint rather longer than the rest; club oval or oblong oval; rostrum moderate, rather arched; thorax often broader than long, narrower towards the apex, and furnished with tufts on the anterior part; elytra somewhat ovate, covering the abdomen; scutellum distinct; legs moderate, femora often armed with a spine beneath.

Of this genus upwards of ninety species are known, only one of which inhabits England, *Cryptorhynchus Lapathi*. This beetle is less than half an inch in length, and of a dull brownish-black colour; the thorax is whitish at the sides, and is furnished on the upper part with five black tufts—two on the anterior part near the eyes, and three in a line a little behind these, one in the middle of the thorax, and one on each side; the elytra are brown-white at the base, and white at the apex, and are studded with numerous black tubercles.

C. Lapathi is found on willows, and is sometimes tolerably abundant in osier-beds in the south of England: when touched, like most of its tribe, it contracts its legs and falls to the ground.

CRYPTOSTOMA. [CHISMOBRANCHIATA.]

CRYPTURUS. [TETRAONIDÆ.]

CRYSTALLINE LENS. [EYE.]

CRYSTALLO'GRAPHY, or the doctrine of the relations of crystalline forms, is in strictness an application of solid geometry; but it is practically allied to Mineralogy, and may also be regarded as a subsidiary department of that science.

Minerals occur very generally in the state of crystals, that is, in certain definite and symmetrical forms, and these are regarded as crystals whether they are transparent or opaque.

A solid figure, of the shape of a common die used in games of chance, frequently occurs among minerals, and is then termed a Cube or Cubic Crystal.

If the corners of this cube were to be cut off so as to take away equal portions of the three adjacent edges, a new figure would be produced which is said to be derived from the cube.

If the edges were to be all cut off so as to produce new surfaces, making equal angles with the adjacent sides of the cube, another derived form would result. In these cases the cube would be deemed the primary form, and the derived figures secondary forms of the cube.

Minerals are very generally known by their primary forms; but as these are of different kinds, and as natural crystals are very generally found in secondary forms, from which the primary is to be inferred, a knowledge of the exact relations of the primary and secondary forms is requisite to enable the mineralogist to determine the primary from the secondary, and hence to arrive at a knowledge of the mineral to which any given crystal belongs.

Our subject may therefore be considered under three heads, namely:—

1. Primary Forms.
2. Secondary Forms.
3. The Laws of Derivation, or the mutual relations of the secondary and primary.

We must however premise a few definitions.

What we have called the corners of the cube will be termed its Solid Angles, and so of the corners or points of all other figures.

A solid angle, or edge cut off so as to produce a new surface, or Plane as it is termed, is said to be truncated.

The series of forms resulting from each of the primary forms constitutes a peculiar System of Crystallisation; there are consequently as many different systems as there are different kinds of primary forms.

A Prism is a solid figure, having any number of sides with parallel edges, and its two ends parallel.

A Right Prism is one which stands upright when placed on a table; if it overhangs the base in the direction of an edge or diagonal it is termed oblique, and if an oblique prism is again oblique in the direction of a second edge or diagonal it is doubly oblique. The bases of doubly oblique prisms are usually oblique-angled parallelograms.

The edges of the sides, and the side planes of a prism, are termed lateral, and those of the ends terminal edges and planes.

1. Primary Forms.

These are in some degree arbitrarily assumed, as it appears from the three following figures, showing the relation between the cubes and angular octahedron.

Fig. 1 is a Cube.

Fig. 2, a Cube, with its solid angles truncated.

Fig. 3, an 8-sided figure or octahedron, which is produced when the solid angles are so deeply truncated as to obliterate all the faces of the cube.

Now it is, mathematically speaking, indifferent whether we take the cube or the octahedron as the primary form of all the derived figures of this system of crystallisation; for it may be readily perceived, from an attentive comparison of the following figures, that new planes which might be produced on the octahedron by the truncation of its solid angles would correspond in position with the faces of the

Fig. 1.

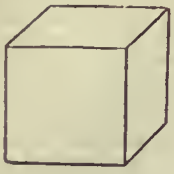


Fig. 2.

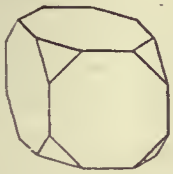
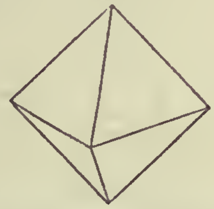


Fig. 3.



cube, and those which would result from the truncation of its edges would correspond in position with those which would result from the truncation of the edges of the cube. The cube might therefore be regarded as the secondary form of the octahedron, arising from the truncation of its six solid angles. Relations of the same nature subsist among the original and derived figures belonging to each kind of the primary forms except the rhomboid. The reason for preferring the one or the other of these as the primary will be considered when we treat of the relations of the different forms of crystals.

We have, for reasons which we shall then state, assumed the following figures as the primary or fundamental forms of all known crystals.

The Cube, *fig.* 1.

The Square Prism, in which, supposing the base of this prism to be of the same dimensions as a side of a given cube, and this and the cube to be both standing on a table, the upright edges would be longer or shorter than those of the cube.

A Right Rhombic Prism, *fig.* 4.
An Oblique Rhombic Prism, *fig.* 5.
A Double-Oblique Prism, *fig.* 6.
A Rhomboid or Rhombohedron, *fig.* 7.

Fig. 4.

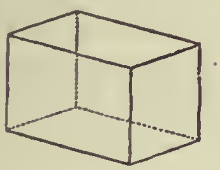


Fig. 5.

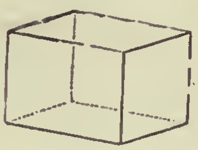


Fig. 6.

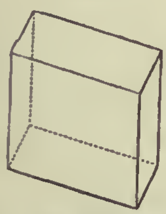
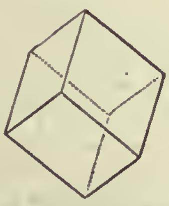


Fig. 7.



The Cube being bounded by six equal square planes, the minerals which assume this form are not distinguishable by the figure of their crystals; but minerals which occur under the other forms may generally be distinguished as follows:—

Those which can be referred to square prisms, by the different proportions which, in each particular case, the lateral edges bear to the terminal edges; and those which belong to the other prisms and to the rhomboid, by the angles at which their planes intersect each other. The ratios of the edges of square prisms may be determined by known algebraical formulæ from the angular measurement of some of the secondary forms, and the angles at which the planes of the other forms meet, may, in many cases, be ascertained by measurement with an instrument called a Goniometer, but in others they must be deduced mathematically from some of their respective secondary forms.

These six primary forms stand in certain relations to each other, which it may not be useless to point out. If the lateral edges of the cube be supposed to be longer or shorter than the terminal edges, a square prism, as we have already seen, would be produced; if two opposite lateral edges of a square prism could be pressed towards each other, the parallelism being kept, a right rhombic prism would be formed; if this prism could be pressed in the direction of either of the diagonals of its terminal plane, so as to make the figure overhang the base in that direction, an oblique-rhombic prism would be represented; and if again pressed in the direction of the other diagonal, so that it would overhang the base in both directions, a doubly-oblique prism would be formed. If we suppose a cube to be made to stand on one of its solid angles by placing the fingers on an opposite one, and if, while held in this position, the two solid angles could be pressed nearer together or drawn further apart, the altered cube would become a rhomboid.

2. Secondary Forms.

These might be produced, and are most conveniently described, by supposed truncations of the solid angles or edges of any of the preceding forms; but as in nature the most minute crystals appear in the shape of secondary forms, it is to be inferred that these modifications of the primary are occasioned by some natural influence operating upon the first germ of the crystal, and continuing during the period of its increase in size.

Secondary Crystals are sometimes altered from the primary only by single sets of planes replacing some of the solid angles or edges; in other cases both the solid angles and edges are replaced by planes in the same secondary crystal; and in others, several different sets of planes appear replacing the solid angles and edges of the same crystals, and producing very numerous and complicated secondary forms. Thus it occurs that the solid angles of the cube are sometimes replaced by three and sometimes by six symmetrical planes, of which several sets may occur on the same crystal, and perhaps with other planes replacing the edges. Similar changes of figure may also occur on each of the other kinds of the primary forms, thus producing the different systems of crystallisation before referred to.

The number of known secondary forms belonging to each system is already very great; in one mineral, carbonate of lime, they amount to many hundreds; but thousands and tens of thousands more might occur under the operation of only a few of the laws of which we shall afterwards treat.

Among the secondary forms of crystals there are some which differ in their characters from those already described. Let us suppose two diagonal lines to be drawn through opposite angles, and crossing each other on the faces of the cube. It may be observed, by referring to *fig.* 2, that the solid angles at the extremities of all these diagonals are truncated to produce the octahedron; but it sometimes happens that the solid angles at the extremities of only one of those diagonals on one plane, and a transverse diagonal on a parallel plane are truncated, producing a four instead of an eight-sided secondary figure; these are termed *hemi* forms, from their presenting only half the number of planes which might be expected from the symmetry of the primary crystal. These defective figures, as they may be termed, from their wanting the number of faces which might be expected on the crystal, are frequently troublesome to the mineralogist, and occasionally mislead him; but there is another, of a much more capricious deviation from the regularity of the simple forms, which is still more troublesome than the preceding; these are what have been termed Hemitrope and Twin Crystals. In twin crystals the two individuals are united in such a manner that if one of them be made to describe a half-revolution round an axis perpendicular to a plane, which is either a face of one of the crystals or which might be one in virtue of the laws of crystallography, it comes into the position of the other.

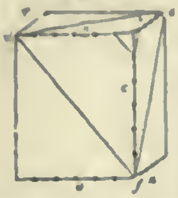
Twin Crystals are produced by the union of two or more crystals according to some regular plan, so that if any number of twin crystals of the same kind of mineral should be found, they would be fashioned in the same manner. Hence these apparently capricious composite figures are subject to definite laws, and are not the results of merely accidental aggregation. There are also two other classes of irregular forms of crystals, one of which, termed by Haüy 'Epigene,' occurs where a crystallised mineral has undergone a chemical change without disintegration or suffering any change of figure; the form in the altered state of the mineral not being proper to the new substance, but remaining that of the original body.

The other class, termed Pseudomorphous, appears as if they had been produced in moulds resulting from the destruction of crystals of other substances which had been inclosed or imbedded in them, and which moulds being filled with some new kind of mineral, the new and intrusive matter assumes the form of the originally inclosed body, and one altogether foreign to its proper shape.

3. The secondary forms of crystals are not derived from the primary by accidental and indefinite truncations of the solid angles and edges, but according to known and definite laws, so that all the possible alterations of figure which any given primary form can undergo, might be determined à priori, if the extreme limits of the relative proportions of the edges considered to be cut off in producing new planes were known. Within well ascertained limits however many thousand of possible secondary forms, belonging to each kind of primary, might be determined with absolute precision.

The laws according to which any secondary planes are produced are termed the laws of those planes. To illustrate the nature of these laws, let *fig.* 8 represent a square prism, whose edges *a b c* are each divided into any equal number of parts, which parts are consequently proportional to the respective edges. Now a new plane, which should cut off one proportion from each of the edges *a b c*, would evidently be parallel to the plane *d e f*, whose edges would coincide with the diagonals of the primary planes. It would carry us beyond the limit to which we must restrict this paper, if we were to enter upon a geometrical consideration of these lines, and we shall therefore confine ourselves to this statement, that if, on any square prism, we find a set of planes truncating its solid angles, and if we assume the edges of these planes to be respectively parallel to the diagonals of the primary planes, the ratio, or comparative lengths of the edges *a* and *c*, may be found, and thus the distinction between prisms of different heights belonging to different minerals may be ascertained. Crystals belonging to the other primary forms may generally be distinguished, as we have already stated, by measurement of the angles at which the planes severally incline to each other. But in order to investigate the laws of their respective secondary planes, we require to know the comparative lengths of the lateral and terminal edges, which may be found by means analogous to those we have just described. The rhomboid however, whose edges, like those of the cube, are all equal, does not require this preliminary investigation, but the laws of new planes may be determined from measurement alone.

Fig. 8.



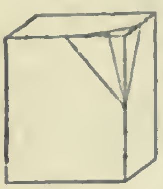
When a plane similar to that shown in *fig.* 8 occurs on one solid angle of a crystal, it generally occurs on all the others, establishing what Haüy has termed the Law of Symmetry. But, as we have before stated in reference to the cube, this law is occasionally deviated from by the production of only one-half the symmetrical number of secondary planes on a square prism. This remark also applies to such other kinds of secondary planes as we now proceed to describe.

Besides the plane shown in *fig.* 8, there are three other kinds affecting the solid angles.

First, such as would cut off one, two, three, or more portions of the edges *a* and *b*, but at the same time some other number from the edge *c*. Thus if one portion be cut from *a* and one from *b*, there will be two, three, four, or some other number cut from *c*; or if three portions were cut from *a* and three from *b*, either one, two, four, five, or some other number would be cut from *c*, so that a numerous series of planes of this nature might occur on each solid anglo.

The second kind of planes are those which would cut off an equal number of parts from *a* and c, but a different number from *b*. But in this case there would be two planes on each solid angle, for if we suppose one plane to cut three parts from *a*, and three from *c*, and two from *b*, a second plane would also be produced, cutting three parts from *b* and c, and two from *a*, producing two planes similar to those in *fig.* 9.

Fig. 9.



Each of the series of planes of the first kind would have an edge parallel to the diagonal *d e*, *fig.* 8; and each of those of the second kind would have edges parallel to the diagonals *d f* and *e f* of the same figure. The planes of the third class also occur in pairs, and are such as would be produced by cutting off dissimilar numbers of parts from the three edges, such as two parts from *a*, three from *b*, and four from *c*, none of the edges of these new planes being parallel to any diagonal.

The secondary planes on the terminal edges may cut off any number of parts from the edges *r* and *b*, and the same, or any other number, from *s* and c. Those on the lateral edges, if they cut unequal portions from *a* and *o*, and *b* and *n*, will be found to occur in pairs. Single planes on the lateral edges are such as would result from cutting *a* and *o*, and *b* and *n*, equally; and the secondary planes on the other primary forms are produced by laws analogous to those we have just described.

The reasons for preferring prisms to octahedrons for the primary forms may be thus briefly stated.

We have already seen that the octahedron derived from the cube might be taken as the fundamental or primary figure of that system of crystallisation. An octahedron derived from the truncation of the upper and lower edges of the square prism, or of its solid angles, by planes which would intersect the terminal planes parallel to their diagonals, might be assumed as the primary form of this system; and octahedrons similarly derived from the other prisms might also be regarded as the primaries of their respective systems. And these figures have accordingly been adopted by Möhs, as the fundamental forms of his system of crystallography. From the greater simplicity however of derivation which results from the assumption of the prisms as primary forms, and the greater mathematical facilities in determining the relations of the derived to the primary, we have been induced to retain them as the fundamental forms of our system. For the relations among these primary and their respective secondary forms are, according to our plan, dependent only upon the proportions of the primary edges required to be cut off to produce given secondary planes. But in taking the octahedrons as primaries, Möhs has founded the relations of these to the secondary figures upon the relative lengths of the axes of the derived figures, according to which view of derivation the lateral planes of the square prism would be denoted as those of an octahedron with an infinitely long axis, and the end planes as those of an octahedron with an infinitely short axis. And for all the various prisms which may occur, octahedrons must first be found, from the infinite prolongation of whose axes the given prisms may be produced. From the complexity of this method it will probably not extend far beyond the school of its highly ingenious author.

The exact relations among primary and secondary forms may be determined mathematically, sometimes from measurement and sometimes from parallelisms between certain edges of the secondary figures: and the mathematical processes may be either those of plane trigonometry, as applied by Haüy; or spherical trigonometry, as used by other authors; or analytical geometry, as applied by Professor Whewell in a paper in the 'Phil. Trans.' for 1825; or by referring the planes of the crystal to the surface of a sphere and denoting their positions stereographically, as shown in a paper by Professor Miller, of Cambridge, in the 'Lond. and Edinb. Phil. Mag.' of Feb. 1835.

Crystallisation and the circumstances under which it takes place form an interesting subject of inquiry, not only in respect of the variety of figures under which crystals present themselves, but in relation to much more comprehensive geological investigations into the formation of the early crystalline rocks and the various embedded crystallised minerals, and into the manner in which the numerous crystalline bodies found in the metallic and other veins have been produced.

From the great length of time during which these natural processes must have been in action, the slowness with which they probably have proceeded, and the hidden recesses in which they have taken place, the progress of natural crystallisation can scarcely be said to have been ever observed; for the production of saline crystals at the bottom of certain lakes, and even that of iron pyrites, which are said to have been observed in a progressive state of formation, cannot be regarded as belonging to the class of phenomena we are contemplating.

Not having therefore the operation of nature open to our inspection, our only sources of information relative to the formation of crystals are those afforded by the processes of artificial crystallisation; and here until very recently our experiments were circumscribed and our views bounded by a very few modes of operation: that of the deposit of crystals from solution in some fluid; their production while gradually cooling from a state of fusion; and their volatilisation by heat or otherwise. Latterly however, by the aid of that universal agent, electricity, new methods of producing crystals have been pursued: much of the darkness in which the subject had been previously involved has been dispelled, and there can now be little doubt that the phenomena of crystallisation are influenced in a greater or less degree by electric influence.

The crystallisation of salts from solution in fluids generally takes place when the solutions are sufficiently evaporated, but the degree of evaporation is very different for different substances. Some salts begin to crystallise at the surface very soon after evaporation commences, and others (for example, sugar) must be evaporated to the consistence of a thick syrup before any crystals will be formed. Hot fluids will generally dissolve more matter than cold ones, and crystals are frequently produced during the cooling of the hot solution. Some soluble substances however cannot be brought to crystallise under any circumstances hitherto tried; but on the solvent evaporating a thick pasty matter is left, which by further evaporation becomes a hard solid mass. Camphor affords an instance of the formation of crystals by volatilisation. The sides of a bottle containing this body may frequently be observed incrusted with brilliant crystals.

The slags of furnaces will frequently be found to contain crystallised matter; and the common rolls of sulphur when broken will frequently present small cavities lined with thin needle-like crystals.

(Austed, *Elementary Geology; Dana, Manual of Mineralogy.*)

CTENACA'NTHUS, a genus of Fossil Placoid Fishes, from the Mountain Limestone and Old Red-Sandstone. (Agassiz.)

CTENODA'CTYLA (Dejean), a genus of Coleopterous Insects belonging to the section *Geodephaga* and sub-section *Truncatipennes*. It has the following characters:—Body but slightly elongated, flattened; thorax longer than broad, truncated posteriorly; terminal joint of the palpi almost oval; three basal joints of the tarsi dilated, nearly triangular or heart-shaped; claws denticulated beneath.

Dejean, in his 'Catalogue des Coléoptères,' only enumerates three species of this genus, all of which are from Guyana. There are however other species known.

C. Chevrolatii is less than half an inch in length, of a blue-black colour above, and brown beneath; the thorax is red, and the legs and antennæ are yellowish-red.

CTENODA'CTYLUS, a genus of Rodent Animals of the family *Arvicolidæ*, established by Dr. J. E. Gray.

Each foot has four toes only, and an obsolete clawless wart in place of the thumb; claws small and falculated; toes pectinated internally, with small bony appendages. Tail very short and hairy.

Dental formula:—Incisors, $\frac{2}{2}$; Molars, $\frac{3-3}{3-3}$. (Gray.)

Dr. Gray is of opinion that this sub-genus appears to be most nearly allied to the Lemmings (*Lemmus*), with which it agrees in teeth and form, but differs from them in only having four free toes on each of the feet and a very obscure clawless wart in place of the thumb, and in the claws of all the feet being short and incurved, those of the hinder ones being covered with a tuft of rigid hair, more especially to be distinguished in the two inner toes, each of which also has a double, small, deeply pectinated, bony plate on its inner side. The tail is very short, scarcely longer than the fur of the back, covered with long bristly hair. The cutting teeth incurved, the lower rounded in front, the upper concavely truncated. The upper grinders are probably like the lower, which are laminar and with a 2-lobed crown, the anterior lobe being transverse, narrow, round on the outer, and narrow and sharp on the inner side; the hinder lobed, larger, and rounded, the lobe of the two anterior ones being rather wider than long, and that of the last as long as it is wide. (Gray.)

C. Massonii, Masson's Comb-Rat. The fur is soft and silky; upper parts fulvous brown; the hair very thin, pale lead-coloured at the base, pale fulvous at the end, with very short blackish tips, especially upon the head; chin, throat, inner side of limbs, and beneath, whitish, with the same lead-coloured base to the hairs. Head rather small, and densely hairy; muzzle very small, black; mouth rather small; cutting teeth exposed, rounded and smooth in front, white; the whiskers very long, twice as long as the head, rigid, black, with two or three slender long bristles over the eyebrows; eyes moderate, rather nearer the ears than the end of the nose; the ears rounded, externally covered with dense short fur like the body, internally rather naked, black, with a distinct helix. Limbs short; the feet covered with shortish rather adpressed hair; the fore feet short; the toes free, the two middle ones nearly equal, the inner rather shorter, and the outer shortest of all; the claws short, subequal, incurved, black, not so long as the hinder ones; the hinder feet large with naked soles; toes free, the three inner equal, the outer rather the shortest, the two inner toes with two series of four or five bony laminæ placed side by side, forming a comb-like process, and covered with some very stiff bristly incurved hair; the tail very short, cylindrical, ending in a parcel of rather rigid black-tipped hairs. Size and shape about that of a half-grown guinea-pig. Length (stuffed specimen) from nose to base of tail 9 inches; of the tail 1 inch (the longest bristle extends beyond the tip); of the hind feet, $1\frac{1}{8}$ inch; of the ears, $\frac{3}{12}$ of an inch. (Gray.) Locality, Cape of Good Hope.

"I am not aware," says Dr. Gray, speaking of the comb-like appendage, "of the same kind of process being found on the toes of any of the *Mammalia*. It most nearly resembles the pectinated edge of the claws of the middle toes of the feet of the Goatsuckers and Herons: it may probably be used for the same purpose to clear their coats of intruding insects, and this idea is strengthened by the fact of the two living animals in the collection of the Zoological Society, said to come from Barbary, continually scratching themselves with their hind claws. Some of the Lemmings, to which these animals are most nearly allied, are peculiar for having a very curious conformation in the claw of the index finger of the hand."

Dr. J. E. Gray refers to two specimens in the British Museum, one of which is marked in the hand-writing of his late uncle, Dr. E. W. Gray. "C. B. Spei Masson, 1744, appears to be a variation of No. 1," which last Dr. Gray thinks is probably the other specimen in the British Museum, which is rather larger.

The species is named after Mr. Francis Masson, who was one of his Majesty's gardeners, and published a paper in 'Phil. Trans.,' lxvi. (1775), giving an account of three journeys from Cape Town to the southern parts of Africa, undertaken for the discovery of new plants towards the improvement of the Royal Botanical Gardens at Kew.

The description of this curious animal is taken from Dr. Gray's 'Spicilegia Zoologica,' where there is a figure of the species.

CTE'NODUS, a genus of Fossil Fishes, from the Coal Formation of Yorkshire and Lancashire, and the Limestone of Burdie-House. (Agassiz.)

CTENOID FISHES, a great division of Fishes, thus named by Agassiz, from the pectinated appearance of the retral edges of the scales, which are of a horny substance, not bony nor enamelled. Abundant in the actual creation, they are rare as fossils in all but the more recent strata.

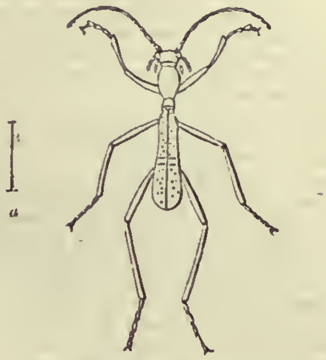
CTENO'LEPIS, a genus of Fossil Fishes, from the Oolite of Stonesfield. (Agassiz.)

CTENOMYS, a genus of Rodent Animals. [MURIDÆ.]

CTENO'STOMA (Klug), a genus of Coleopterous Insects of the section *Geodephaga* and family *Cicindelidæ*. The species have the following distinguishing characters:—The basal joints of the anterior tarsi dilated in the male sex, the third with an obliquely elongated portion on the inner side; body narrow and long; thorax long, somewhat globular in the middle, and suddenly constricted towards the base and apex; antennæ setaceous; palpi long and distinct; mentum furnished with a tooth-like process in the anterior and emarginated part.

Ctenostoma macilentum (Klug), is about half an inch in length, and of a brassy-black colour; the elytra are distinctly punctured, and have a transverse yellowish fascia in the middle; the legs are yellowish.

This species is from Buenos Ayres. Eight or nine other species are known, all of which inhabit South America: several are from Brazil.



Ctenostoma macilentum.
a, denotes the natural length.

Under this head may be noticed three other genera which are closely allied to the one just described—*Therates*, *Tricondyla*, and *Colliurus*.

The species of these three genera are at once distinguished from those of *Ctenostoma* by their having no tooth-like process in the emargination of the mentum. The principal characters of the genus *Therates* (Latreille) are as follows:—Tarsi nearly the same in both sexes, the third joint shorter than the two basal joints, and notched at the extremity; fourth joint very short and heart-shaped; internal maxillary-palpi very small, and consisting of one joint only.

The species of this genus are of an intermediate form between *Ctenostoma* and *Cicindela*: they are shorter and broader in proportion than those of the former, and hence approach the latter; but the thorax is of that same globular form (though short) as observed in *Ctenostoma*.

Only four or five species are known, and these are from Java and Guinea: their colouring is very brilliant.

Therates labiata is of a brilliant blue colour, with violet reflections; the elytra are nearly double the width of the thorax; the labrum, femora, and abdomen, are of a reddish-yellow colour.

The species of the genus *Tricondyla* (Latreille) very much resemble, in form and general appearance, those of *Ctenostoma*; but they may be distinguished by their having the joints of the tarsi nearly equal in length, the three basal joints of the anterior tarsi of the males dilated, the third being prolonged obliquely on the inner side, and the palpi being less conspicuous from their comparatively smaller size.

Of this genus three species are known: they inhabit the islands north of Australia.

The technical characters of the genus *Colliurus* are:—fourth joint of all the tarsi prolonged on the inner side in both sexes; thorax elongate, nearly cylindrical, and constricted near the base and apex; body elongate, nearly cylindrical, broader towards the posterior part; antennæ short, slightly thickened towards the apex.

All the species of this genus as yet discovered (which amount to only four or five) are found in the southern parts of Asia, and in the islands north of Australia.

Colliurus emarginata (Dejean), is about an inch in length, and of a dull blue colour; the elytra are coarsely punctured, and truncated at their apex; the legs are black, with the exception of the thighs, which are red.

CUBAN, a native Sulphuret of Copper and Iron.

CUBE-ORE, a native hydrous Arsenate of the Peroxide of Iron. It crystallises in cubes, and is found in the mines of Cornwall, France and Saxony. [PHARMACOSIDERITE.]

CUBE-SPAR, a name by which *Anhydrite* is known. [ANHYDRITE.]

CUBEBA. [PIPER.]

CUBICITE. [ANALCIME.]

CUBOIDES. [ACALEPHÆ.]

CUCKOO. [CUCULIDÆ.]

CUCKOO-FLOWER. [CARDAMINE.]

CUCKOO-PINT. [AROIDEÆ.]

CUCUBALUS, a genus of Jelly-Fishes. [ACALEPHÆ.]

CUCU'BALUS, a genus of Plants belonging to the natural order *Caryophyllaceæ*. It has a 5-toothed naked calyx; 5-clawed petals; 10 stamens; 3 styles; capsule a globose 1-celled berry; reniform seeds. There is but one species of this genus, *C. baccifer*, the Berry-Bearing Campion. It differs but little from the species of *Silene* except in its berried capsule, which is black. It is a native of Europe, and has been found wild in Great Britain. It has been undoubtedly introduced, but is scarcely naturalised. (Babington, *Manual.*)

CUCULÆA. [POLYODONTA.]

CUCU'LIDÆ, the *Cuckoo-Tribe*, or Cuckoos, a family of Scansorial Birds, placed by Cuvier and Lesson next to the Wrynecks, *Yunx*, and by Mr. Vigors in the aberrant group of his *Scansores*, between the *Certhiadæ* and the *Rhamphastidæ*.

The *Cuculidæ* are placed by Mr. Swainson also between the *Certhiadæ* and *Ramphastidæ*, and these three families constitute what he terms his third and aberrant circle of the *Scansores*. The following is his definition of the family character:—Feet not strictly scansorial, very short, nostrils naked, tail-covers remarkably long; and he separates the group into the following sub-families: *Cuculinæ*, *Coccyzinæ*, *Saurotherinæ*, *Opisthocominæ*, *Indicatorinæ*. Of the first sub-family *Cuculus*, Linn., is the type; of the second *Coccyzus*, Vieill.; of the third *Saurothera*, Vieill.; of the fourth *Opisthocomus*, Hoff.; and of the fifth *Indicator*, Sparrm.

The following account of this family by Mr. Swainson bears the stamp of actual observation. "So faintly is the scansorial structure indicated in these birds that but for their natural habits, joined to the position of their toes, we should not suspect they were so intimately connected with the more typical groups of the tribe as they undoubtedly are. They neither use their bill for climbing, like the parrots, or for making holes in trees, like the woodpeckers, neither can they mount the perpendicular stems, like the *Certhiadæ*, or Creepers; and yet they decidedly climb, although in a manner peculiar to themselves. Having frequently seen different species of the Brazilian cuckoos (forming part of the genus *Coccyzus*) in their native forests, I may safely affirm that they climb in all other directions than that of the perpendicular. Their flight is so feeble, from the extreme shortness of their wings, that it is evidently performed with difficulty, and it is never exercised but to convey them from one tree to another, and these flights in the thickly-wooded tracts of tropical America are of course very short: they alight upon the highest boughs, and immediately begin to explore the horizontal and slanting ramifications with the greatest assiduity, threading the most tangled mazes and leaving none unexamined. All soft insects inhabiting such situations lying in their route become their prey, and the quantities that are thus destroyed must be very great. In passing from one bough to another they simply hop, without using their wings, and their motions are so quick, that an unpractised observer, even if placed immediately beneath the tree, would soon lose sight of the bird. The Brazilian hunters give to their cuckoos the general name of Cat's-Tail; nor is the epithet inappropriate, for their long hanging tails, no less than their mode of climbing the branches, give them some distant resemblance to that quadruped. I have no doubt that the great length of tail possessed by nearly all the cuckoos is given to them as a sort of balance, just as a rope-dancer, with such an instrument in his hands, preserves his footing when otherwise he would assuredly fall. Remote therefore as the cuckoos unquestionably are from the typical *Scansores*, we yet find the functions of the tail contributing to that office, although in a very different mode to that which it performs among the woodpeckers, the parrots, and the creepers. The structure of the feet, as before observed, is the only circumstance which would lead an ornithologist to place these birds among the climbers, supposing he was entirely unacquainted with their natural history properly so called, or with their close affinity to the more perfect *Scansores*. The toes indeed are placed in pairs; that is, two directed forward and two apparently backward; but a closer inspection will show that the latter are not strictly posterior, and that they differ so very materially from those of the *Picidæ* (the pre-eminently typical family of the climbers), as clearly to indicate a different use. The organisation of the external posterior toe of all the woodpeckers, parrots, and toucans, renders it incapable of being brought forward, even in the slightest degree; whereas in the cuckoos this toe can be made to form a right angle with that which is next it in front, from which circumstance it has been termed versatile; this term however is not strictly correct, inasmuch as the toe cannot be brought more than half way forward, although it can be placed entirely backward. Now this form, which is obviously the least developed state of the scansorial structure, accords exactly with the rank of the family, which is that of the most aberrant group in the circle, and farthest removed from the type. The cuckoos in fact are half-perching half-climbing birds, not only in their feet, but, as we have seen, in their manners. No one, from seeing them alive, would suppose they were truly scansorial birds; and yet it is highly probable that this singular power of varying the position of one of their toes gives them that quickness of motion and firmness of holding which accompanies the habit just mentioned.

"There is another circumstance in the history of this family of birds, which, with one solitary exception, is altogether peculiar, as they contain the only parasitic birds yet known. This term indeed has been applied, I think improperly, to other genera, which, like the frigate pelicans, the jagers, and some of the eagles, rob other birds of their food; but this is a mere act of thieving, for all these feathered robbers can and do habitually depend just as much upon their own industry in procuring food. But with the typical cuckoos the case is far different, for, by depositing their eggs in the nests of other birds, to whom they leave the care of hatching their young and feeding them afterwards, they become as truly parasitic as any of the *Acari* or *Pediculi*; they fasten themselves, as it were, on the living animal, whose animal heat brings their young into life, whose food they alone live upon, and whose death would cause theirs during the period of infancy. Such only is a parasitic animal, and such only, among birds, belong to the typical cuckoos and their representative, the *Molothrus pecoris*." [MOLOTHRUS.]

Warm and temperate climates are the chosen haunts of the Cuckoos. The European species—there are but two—never show themselves in our quarter of the globe, except in the warm weather, quitting it upon the first approaches of a colder temperature. "So congenial is warmth to their nature," says Mr. Swainson in the memoirs last quoted, "that even the mild temperature of an Italian winter is not sufficient to retard their return to the sultry groves of Northern Africa. There is a fact regarding their structure which appears connected with this susceptibility of cold, and which I believe has not hitherto been noticed. All the cuckoos, both of the old and the new world, which I have had the opportunity of dissecting, are remarkable for the thinness and delicacy of their skins, so much so indeed as to render their preservation in an entire state extremely difficult to inexperienced hands. Every one who has skinned the common British species must doubtless have observed this. On the other hand, as if to compensate for the delicacy of the cuticle, the feathers, more especially upon the back and rump, are unusually thick-set and compact."

Tropical countries, and those which approach the equator, afford the greatest number of species.

The food of the Cuckoos, as might be expected from this geographical distribution, consists principally of soft fruits and soft insects, especially the latter, and more particularly when they are in the larva state.

Cuculinæ include the genuine Cuckoos. This sub-family has the following characters:—Bill wider at the base than it is high, rather suddenly contracted behind the nostrils and becoming compressed; upper mandible slightly sinuous at the tip, so as to assume the form of the dentirostal notch. Wings considerably long, nearly reaching to two-thirds the length of the tail, and so far pointed as to diminish rapidly in length beyond the fourth quill. Feet remarkably short; tarsus thickly clothed with feathers for nearly half its length, not longer than the hallux or true hind toe. Upper cover-feathers of the tail thick-set, narrow, generally pointed, and comparatively elongated, and in rigidity only comparable to those of the *Ceblepyrinæ*, the corresponding type in the *Laniadæ*.

"Popular interest," adds Mr. Swainson, "has been so much confined to the parasitic habits of the cuckoo, that upon many other points of its economy we are still in comparative ignorance. Hence it is that we cannot trace, so fully as could be wished, the influence which the structure just described exercises upon the habits and manners of such birds as possess it. We know however that all the genuine cuckoos fly with strength and rapidity. Most of them, in fact, are migratory birds. . . . . The form of the nostrils in the typical cuckoos is very peculiar, and I believe that future observations will shew this structure to be intimately connected with their parasitic habits. The nests of those species in which the cuckoo deposits its eggs, we all know, are built in the thickest and most central part of trees and bushes, to discover which, superior powers of smell have been given to the toucans (which feed upon the eggs or young), and, in a less degree, are probably conferred upon the cuckoos, to facilitate their search after a foster-parent for their young. How far this idea may be correct future observations will determine. Certain however it is, that this peculiar-shaped nostril is restricted to such cuckoos as are parasitic, for the whole of the *Coccyzinæ* have the aperture of a lengthened oval shape, or in the form of a slit, and all we know of these birds sanctions the idea that they are not parasitic. The shortness of the feet, in the typical cuckoos, is another important distinction, and leads to the belief that these members are much less used than those of the *Coccyzinæ*, whose habits we have already mentioned when alluding to the cuckoos of South America, all of which are excluded from the group now under consideration."

Cuculus.—Bill broad at the base, compressed beyond, the upper mandible obsoletely notched; nostrils circular, with a tumid margin; wings long, pointed, the third quill longest, the second and fourth of equal length; feet slender, very short, tarsi feathered posteriorly almost to the toes; rump and upper tail-covers long, thick-set, and rigid. Inhabits the Old World. Parasitic.

C. canorus, the Cuckoo. It is the Κόκκυξ of the Greeks; *Cuculus* and *Coccyx* of the Romans; Cucculo, Cucco, Cuco, Cucho, Cuccu, of the Italians; Cocuo, Coucou, Coqu, of the French; Kukuk and Kuckuck of the Germans; Gjok of the 'Fauna Suecica;' Gjoeg of the Danes; Gouk of the Norwegians; Cog of the Welsh; Gowk and Cuckoo of the British.

Length about 14 inches, weight about four ounces and a half. Bill black, yellowish at the base of the upper mandible; inside of mouth red. Irides yellow. Head, and whole upper part of the bird, dark ash-colour. Throat, under side of the neck, and upper part of breast, pale ash, the latter sometimes inclining to rufous brown; lower part of breast and belly white, with transverse undulating black lines. Quills dusky, inner webs barred with white oval spots. Tail-feathers ten, of unequal length; two middle ones black, dashed with ash and tipped with white, the rest black, with white spots on each side of the shaft. The lateral feathers in some have white spots only on the interior webs, but all are tipped with white. Female, rather less than male, and differing from him generally in the neck and breast being of a tawnyish brown, barred with dusky, and the coverts of the wings marked with light ferruginous spots. Tail-feathers and quills much like those of the male, but the edges of the spots incline to reddish-brown. Legs in both sexes short and yellow. Outer tail-feather and first quill remarkably short.

Cuckoo (*Cuculus canorus*), male.

The young is so distinct in its plumage from the adult that it has been described as a distinct species (*C. rufus*, Bris). It is supposed not to throw off its nestling feathers till the second year's moulting, for it is stated in Montagu's 'Dictionary' (last edit.), that in three specimens killed the same season (two males and a female), the thirteenth and three succeeding quill-feathers, and the three greater coverts impending them, are barred with brown and ferruginous. In the first year the irides are grayish; the whole upper plumage is a mixture of dusky black and ferruginous, in transverse bars, except the forehead and a patch on the back of the head, which in this specimen described in Montagu was white, and the tips of the scapulars pale; the feathers of the whole under parts sullied white, with distant transverse bars of dusky black. In general each feather is barred twice or thrice. The sides of the neck and breast are tinged with rufous; lateral tail-feathers and inner webs of the quills more or less barred with white. Tail coverts, which, as well as the feathers on the rump, are unusually long, dashed with cinereous and slightly tipped with white.

The Common Cuckoo arrives in this country early in spring. In White's 'Naturalist's Calendar,' the Cuckoo is noted as first heard April 7-26, and in Markwick's, April 15, May 3; last heard June 28. By the 1st of July it has almost always taken its departure, but it is sometimes later. Mr. Swainson, in his 'Memoir on the Cuculidæ,' says, "The common species comes to us every spring, from northern Africa or Asia Minor, and returns in autumn. This we know from personal observation; for vast numbers arrive in the spring in Sicily and Naples, in company with the bee-eaters, orioles, hoopoes, and other migratory birds; but after remaining a short time, they appear to direct their flight northward, from whence they return in August and September." Speaking of the food, the same author observes, "The English cuckoo, no doubt, searches for its food among foliage, but its nature is so shy that we have never been fortunate enough to witness its mode of feeding." Montagu however, one of the best authorities we can cite, says, that "its principal food consists of caterpillars, so that it not only possesses the general cast of colours, and much of the structure of its prototypes, the *Ceblepyrinæ*, but actually feeds on the same description of insects." The Editor of the 'Magazine of Zoology and Botany' adds, "In an open and muirland district where the cuckoo is very common, we have always found, during May and June, that their stomachs were filled with the remains of caterpillars which fed on the various plants frequent in such localities. Among them those of the *Lasiocampæ* formed a great proportion, and hairy species seem to be preferred." White, in his 'History of Selborne,' thus writes: "In July I saw several cuckoos skimming over a large pond; and found, after some observation, that they were feeding on the *Libellulæ*, or Dragon-Flies; some of which they caught as they settled on the weeds, and some as they were on the wing." The following narrative from the last edition of Montagu's 'Dictionary' will throw some light on this part of the subject: "A young cuckoo, brought to Colonel Montagu in the month of July, just as it could fly, was, by great care, kept alive till the fourteenth of December. It had, during that time, two or three attacks of dysentery, from which it recovered by having chalk and ginger given to it; and during the time it lived no change was observed to have taken place in its plumage. For two months after this bird was caught, it never attempted to feed itself by picking; and even to the last moment seemed to prefer being fed by the hand of its mistress rather than have the trouble of picking up its food, of which it was extremely choice. Nothing appeared to be acceptable as a substitute for insects except raw beef. Flies it would eagerly devour; but its most delicious morsel was any species of hairy caterpillars; these it seized with avidity, shook them to death, and softened by passing several times through the bill, till they were perfectly pliant, when it would swallow whole the largest of the caterpillars of the egger or drinker moths. Of strangers it was extremely fearful, fluttering in its cage to avoid their attentions; but it would quietly suffer itself to be handled and caressed by a young lady who had been its kind benefactress, appearing to like the warmth of her hand to its feet."

It is the habit of the Cuckoo in depositing her egg in the nest of another bird that has made it so much an object of curiosity. Many strange stories were formerly rife on this custom, which can hardly be called abandonment, as the nest of a bird that feeds its young with insects is always selected. Among others, the hedge-sparrow, the reed-sparrow, the tit-lark, the water-wagtail, the yellow-hammer, &c., have been recorded as the birds to whom the egg has been committed, but the first seems to be most frequently chosen. White saw one hatched in the nest of the tit-lark. The nests of the green-bird, the linnet, the white-throat, and even of the wren have been mentioned as the places of deposit. Dr. Jenner's celebrated paper in the 'Philosophical Transactions' threw great light on this subject, and many other observers have corroborated in general that author's remarks. Some indeed, and among them Dr. Fleming, have declared that in some cases the Cuckoo constructs its own nest, but there can be little doubt that there is no foundation for this assertion, and as little that the nests and young supposed to be those of the Cuckoo on such occasions were those of the goatsucker. Whether the bird actually deposits the egg from her body while sitting on the nest has been doubted; and if the case of the deposit of one in a wren's nest be a fact, it is almost conclusive that she does not so deposit it in all cases, for the aperture of the wren's nest is in the side, and not more than big enough to admit the wren. Another observer has recorded the following facts:—"Previous to the above-mentioned publication (Dr. Jenner's) I had taken much pains towards investigating the several phenomena I had noticed in this bird, and was so fortunate as to have ocular proof of the fact, related by Dr. Jenner, of a young cuckoo turning out of a hedge-sparrow's nest a young swallow I had put in for the purpose of experiment. It is needless to recite all the circumstances attending this extraordinary bird, as that gentleman has so amply explained it; I shall therefore only add, that I first saw it when a few days old, in the hedge-sparrow's nest, in a garden close to a cottage, the owner of which assured me the hedge-sparrow had four eggs, when the cuckoo dropped in a fifth; that on the morning the young cuckoo was hatched, two young hedge-sparrows were also excluded; and that, on his return from work in the evening, nothing was left in the nest but the cuckoo. At five or six days old, I took it to my house, when I frequently saw it throw out the young swallow for four or five days after. This singular action was performed by insinuating itself under the swallow, and with its rump forcing it out of the nest with a sort of jerk. Sometimes indeed it failed, after much struggling, by reason of the strength of the swallow, which was nearly full feathered; but, after a small respite from the seeming fatigue, it renewed its efforts, and seemed continually restless till it succeeded. At the end of the fifth day this disposition ceased, and it suffered the swallow to remain in the nest unmolested." This wonderful instinct is absolutely necessary for the self-preservation of the young Cuckoo, which, if it did not dispose of all other claimants on the affection of the parents, must perish for want, and, as it is, the poor little birds to whose lot it falls to supply the demands of their craving and gigantic nestling, have a weary time of it. Indeed there are well recorded instances of their being assisted by others of their own species, and by other insectivorous birds.

The Romans considered the Cuckoo excellent eating. Pliny (lib. x. c. 9) says that no bird can be compared to it for sweetness of flesh.

C. glandarius, the Great Spotted Cuckoo, is a native of Senegal and North Africa. It has been observed on the continent of Europe, and a specimen is recorded by Mr. R. Ball as having been taken in Ireland.

Oxylophus (Sw.)—Bill slender, considerably compressed nearly its whole length; upper mandible entire; nostrils ovately round; head crested; wings moderate, pointed, shorter than the tail-covers, the fourth quill longest; tarsi moderate, naked; upper tail-covers long but not rigid. The species inhabit the Old World; and are parasitic.

O. Levaillantii.—Head crested, the feathers pointed; plumage above, black glossed with green; band at the base of the quills, end of the tail, and under parts of the body, white; throat striped with black. Wings long but rounded, fifth quill longest. Total length, 15 inches. Mr. Swainson, whose description we have given, says that, unlike the true Cuckoos, these birds rear and provide for their young in the ordinary manner. Locality, Senegal and the western coast of Africa.

Oxylophus Levaillantii.

Erythrophrys (Sw.)—Bill as in *Oxylophus;* head not crested; nostrils oval; wings lengthened, pointed, extending beyond the tail-covers, the third quill longest, the second much shorter than the fourth; tarsi moderate, naked. They inhabit the New World, and rear their own young.

E. Americanus (*Cuculus Carolinensis*, Wilson).—The male has the bill as long as the head, compressed, slightly arched, acute, scarcely more robust than in many *Sylviæ;* upper mandible carinated above, its margins acute and entire; lower mandible carinated beneath, acute. Nostrils basal, lateral, linear-elliptical, half-closed by a membrane. Feet short, tarsus scutellate before and behind; toes two before, separated; two behind, one of which is versatile, the sole flat; claws slender, compressed, arched. Plumage blended, slightly glossed. Wings long, the first quill short, the third longest, the primaries tapering. Tail long, graduated, of ten feathers, which are rather

Coucou (*Erythrophrys Americanus*).

narrow and rounded. Upper mandible brownish black, yellow on the margin towards the base; under mandible yellow. Iris hazel. Feet grayish-blue. The general colour of the upper parts, including the wing-coverts and two middle tail-feathers, is light greenish-brown, deeper anteriorly. Primary quills with the inner webs brownish-orange. Tail-feathers, excepting the two middle ones, black, the next two entirely black, the rest broadly tipped with white, the outermost white on the outer web. The under parts are grayish-white. Length, 12½ inches; extent of wings, 16 inches; bill along the ridge, 1 inch; along the gap, one inch and a third. The female differs very little from the male in colouring. (Audubon.)

The author whose specific description we have given above, thus graphically describes the habits of the Yellow-Billed Cuckoo (*Cuculus Carolinensis* of Wilson, *Coccyzus Americanus* of the Prince of Canino, *Cuculus Americanus* of Linnæus, and Carolina Cookoo of Latham. "The flight of the bird is rapid, silent, and horizontal, as it moves from one tree to another, or across a field or river, and is generally continued amongst the branches of the trees in our woods. When making its way among the branches, it occasionally inclines the body to either side, so as alternately to show its whole upper or under parts. During its southward migration it flies high in the air, and in such loose flocks that the birds might seem to follow each other, instead of their keeping company together. On the other hand, early in March, the greater number enter our southern boundaries singly, the males arriving first, and the females a few weeks after. They do not fly in a continued line, but in a broad front, as, while travelling with great rapidity in a steam-boat, so as to include a range of a hundred miles in one day, I have observed this cuckoo crossing the Mississippi at many different points on the same day. At this season they resort to the deepest shades of the forests, and intimate their presence by the frequent repetition of their dull and unmusical notes, which are not unlike those of the young bull-frog. These notes may be represented by the word 'cow, cow,' repeated eight or ten times with increasing rapidity. In fact, from the resemblance of its notes to that word, this Cuckoo is named Cow-Bird in nearly every part of the Union. The Dutch farmers of Pennsylvania know it better by the name of Rain-Crow, and in Louisiana the French settlers call it Coucou. It robs smaller birds of their eggs, which it sucks on all occasions, and is cowardly and shy, without being vigilant. On this latter account it often falls a prey to several species of Hawks, of which the Pigeon-Hawk (*Falco columbarius*) may be considered as its most dangerous enemy. It prefers the southern states for its residence, and when very mild winters occur in Louisiana some individuals remain there, not finding it necessary to go farther south. This bird is not abundant anywhere, and yet is found very far north. I have met with it in all the low grounds and damp places in Massachusetts, along the line of Upper Canada, pretty high on the Mississippi and Arkansas, and in every state between these boundary-lines. Its appearance in the state of New York seldom takes place before the beginning of May, and at Green Bay not until the middle of that month. A pair here and there seem to appropriate certain tracts to themselves, where they rear their young in peace and plenty. They feed on insects, such as caterpillars and butterflies, as well as on berries of many kinds, evincing a special predilection for the mulberry. In autumn they eat many grapes, and I have seen them supporting themselves by a momentary motion of their wings opposite a bunch, as if selecting the ripest, when they would seize it and return to a branch, repeating their visits in this manner until satiated. They now and then descend to the ground to pick up a wood-snail or a beetle. They are extremely awkward at walking, and move in an ambling manner, or leap along sidewise, for which the shortness of their legs is ample excuse. They are seldom seen perched conspicuously on a twig, but on the contrary are generally to be found amongst the thickest boughs and foliage, where they emit their notes until late in autumn, at which time they discontinue them. The nest is simple, flat, composed of a few dry sticks and grass, formed much like that of the common dove, and like it fastened to a horizontal branch, often within the reach of man, who seldom disturbs it. It makes no particular selection as to situation or the nature of the tree, but settles anywhere indiscriminately. The eggs are four or five, of a rather elongated oval form, and bright green colour. They rear only one brood in a season, unless the eggs are removed or destroyed. The young are principally fed with insects during the first weeks. Towards autumn they become very fat, and are fit for being eaten, although few persons, excepting the Creoles of Louisiana, shoot them for the table." ('Ornithological Biography,' vol. i. p. 18.)

Chalcites, Less.—Bill and general structure as in *Cuculus*. Plumage metallic green; upper mandible entire; nostrils circular; wings pointed, the third quill longest, the second much longer than the fourth; tarsi very short, almost entirely plumed; rump and upper tail-covers soft. Inhabits the tropics of the Old World. Parasitic.

C. auratus; Cuculus auratus of authors (Swainson). Of this genus Mr. Swainson says, "I feel much more scrupulous in adopting the genus *Chalcites*, than in proposing that of *Erythrophrys*. The beautiful little shining cuckoos, indeed, which have thus been detached, have altogether the appearance of belonging to a different type from those of the genus *Cuculus;* and this idea is strengthened, when we find that there are already four or five species, all distinguished at first sight by their diminutive size and their beautiful golden-green plumage. On the other hand, their actual structure is so completely that of an European group, that I must beg to be understood as being by no means satisfied on the propriety of the separation. For the present however I shall adopt this genus, conceiving that these splendid little birds may probably constitute the tenuirostral type of the *Cuculinæ*, in which case they will be analogous to the humming-birds, and nearly all those genera whose plumage is ornamented with metallic colours. The attempt that has been made to define the group by its bill, nostrils, &c., as distinct from the cuckoos, is singularly unsuccessful; while those light shades of difference really existing between *Chalcites* and *Cuculus* have been completely overlooked. *Chalcites*, in fact, has the bill, nostrils, feet, and wings of *Cuculus*, with this difference only, that the tip of the upper mandible is without the slightest indication of a notch; the second and third quills are longer than the fourth, and the feathers of the rump and upper tail-covers, instead of being thick-set and rigid, are of the same degree of density and softness as in ordinary birds. We have seen that, however dissimilar in their appearance the foregoing groups of the *Cuculinæ* may be, yet that the variation of their external structure is but slight. This consideration has much weight with me in the temporary adoption of M. Lesson's genus *Chalcites*, for we have just seen an example in *Erythrophrys*, where there is an equally slight variation in external form, yet a most important one in economy and internal organisation." ('Mag. of Zool. and Bot.')

Chalcites auratus.

Eudynamys, Horsf. and Vig.—Bill strong, thick, the under mandible not curved, and angulated beneath; upper mandible entire; wings pointed, the fourth quill longest; tarsi much shorter than the longest toe; the upper part plumed; rump and tail-covers soft. Inhabits the Old World.

Mr. Vigors and Dr. Horsfield, who established this genus in their description of the Australian birds in the collection of the Linnæan Society ('Linn. Trans.,' vol. xv. p. 303), observe that the true Cuckoos, or that portion of the family of *Cuculidæ* which constitutes the genus *Cuculus* of authors, is distinguished from the remaining groups of the family by the comparative weakness of the bill, in which the nares are small and rounded, and situated on an elevated membrane; by the wings being strongly acuminated, the primary quill-feathers considerably exceeding the secondary in length; and by the feebleness of the legs and toes, the former of which are plumed beneath the knee, and are generally covered by the feathers. *Eudynamys*, they state, deviates from these characters, which may be considered typical in the family, by the greater strength of all these members. The bill is powerful, the under mandible more particularly, which is marked by a strong ascending gonys. The nostrils are wide and oval, and covered only on the upper part by a membrane. The tarsi and feet are particularly strong; the former are much compressed on the external side, exhibiting by this conformation a nearly flattened surface in front. In many of these particulars the group agrees very nearly with the neighbouring genera, *Centropus*, Ill., and *Phœnicophaus*, Vieill., which have equally been separated from the typical species of the family. But it may at once be distinguished from *Centropus* by the absence of the lengthened nail to the hallux; and it will be seen equally to differ from *Phœnicophaus* in its stronger, shorter, and less arcuated bill, in the wings being longer, and the tail rounded, not graduated. The compressed formation of the sides of the tarsi in *Eudynamys* is also wanting in *Phœnicophaus*.

The species are widely distributed over the East.

E. Orientalis; Cuculus Orientalis, Linn.; Coucou des Indes Orientales, 'Enl.'; Eastern Black Cuckoo, Lath.

The plumage of the male is black with metallic lustre. Bill yellow. The female is shining greenish-brown above, spotted with white; tail-feathers banded with white; whitish beneath, transversely undulated with greenish-brown. The synonyms of the female are *Cuculus Mindanensis*, Linn.; Coucou Tacheté de Mindanao, 'Enl.' 277.; Mindanao Cuckoo, Lath. (Vigors and Horsfield.)

Eastern Black Cuckoo (*Eudynamys Orientalis*).

"These birds, which now generally are considered the sexes of one species, appear to be but accidental visitors in the colony. At least Mr. Caley informs us that he never met with more than two individuals of the male and one of the female. The male specimen in the society's collection seems to be a young bird changing to the adult plumage. It has several pale ferruginous feathers in the lower parts of the body, and it has a single ferruginous feather streaked with black among the secondary quill-feathers of the right wing, which forms a striking contrast with the deep black of the rest. The corresponding feather on the left wing was lost, as Mr. Caley tells us, by the shot striking the wing. This bird had berries of *Cassytha* in its stomach. The native name of the male is Cowhat, of the female, Bellingiug." (Vigors and Horsfield.)

"All the cuckoos I have yet seen," says Mr. Swainson in his 'Memoirs on the Cuculidæ,' "with more or less pointed wings, and circular nostrils, and whose habits are parasitic, will arrange themselves under one or other of the foregoing genera. Nor are there wanting considerations, drawn from their analogical resemblances in other groups, which render it highly probable that they serve to indicate a circular group. *Erythrophrys*, as the rasorial type, resembles the rufous-winged scansorial creeper; and as it is by this group that the parasitic cuckoos lead immediately to those which build nests, so we have the external characters of *Oxylophus* joined to the economy of *Coccyzus*. *Chalcites*, again, as representing the humming-birds, may be viewed as the tenuirostral type; while *Eudynamys*, with its large bill, and black glossy plumage, will become the representative of the toucans, and of the fissirostral type. It may be questioned, indeed, whether *Cuculus* or *Oxylophus* follows *Eudynamys*; but I incline to the series in which they are here placed, from the obvious affinity of *Erythrophrys* to *Oxylophus*." ('Mag. of Zool. and Bot.')

The family *Indicatorinæ* includes the Honey-Guides. There appears to be but one genus, *Indicator* (Le Vaillant), which is thus characterised:—Bill straight, Finch-like, the base triangular, the sides compressed. Culmen and gonys equally inclined towards the tip; gonys angulated. Wings lengthened, pointed. Tail moderate, rounded. Feet short. Middle toe much longer than the tarsus.

Mr. Swainson is of opinion that the nearest approach to the Creepers yet known is made by the African Honey-Guides, whose bill is not unlike *Orthonyx*; and he adds that these birds are said to climb in a more perpendicular manner than any others of this family; the same zoologist has pointed out the affinity of *Indicator* to *Buphaga*.

The species are not numerous. The stories told of these birds indicating the nests of bees and guiding men to them by their motions and cries, from the time of Sparrman downwards, appear to be perfectly authentic, though some great travellers affected to disbelieve them. Mr. Swainson censures Bruce and Le Vaillant for their scepticism on this subject, and quotes Mr. Barrow to prove the universality of agreement on this point in the country itself. He farther says, "If more evidence was wanting than this and other similar confirmations of Dr. Sparrman's statement, it will be found in the following note by M. Wiedmann, attached by a label to the specimen from which the subsequent description was taken:—"So soon as this bird sees a man in the woods, where a bees' nest is in the neighbourhood, he flies before the man, and cries 'shirt! shirt! shirt!'" Mr. Swainson then proceeds to describe his *Indicator leucotis* (*I. albirostris*, Temm.). ('Birds of Western Africa;' 'Naturalist's Library;' 'Ornithology,' vol. viii.)

Mr. Steedman, in his 'Wanderings and Adventures in South Africa' (1835), says, "The little honey-sucker, or *Indicator*, kept fluttering before us with its cry of 'cherr, cherr,' as if inviting us to follow. It is frequently known to conduct travellers to a nest of honey deposited in the hollow of a tree. I have however heard many instances mentioned of its stopping short of the hive, and hovering over a spot where a lion or tiger has been reposing, justly establishing its character as an *Indicator*. Mr. Van der Nes informed me that he was once induced to follow it in expectation of discovering honey; and on pushing through the thick brushwood that enveloped the trunk of a tree over which the *Indicator* was hovering, he suddenly came upon a leopard: at the same instant the animal made a spring in a contrary direction, and much to his gratification disappeared without attempting to do him any injury, being evidently as much alarmed at the intrusion as the Veld cornet had been at so unexpected an encounter."

The species of this family are natives of Africa.

The other sub-families belonging to the *Cuculidæ* are, according to Mr. Swainson, *Coccyzinæ*, and *Crotophaginæ*, and *Leptostominæ*.

The *Coccyzinæ*, or Hooked-Billed Cuckoos, are characterised as having the wings short and rounded, the nostrils linear, the bill curved, the margins of the upper mandible dilated, the tarsus naked and lengthened, and the tail very long and concealed.

The genera comprised by Mr. Swainson under this sub-family are the following:—

Serisomus.—Bill short and strong, the gonys thick, ascending, and angulated; the culmen thickened and arched; the tarsus and middle toe equal, the lateral toes unequal, and the claws short. Example, *Serisomus cristatus*. (Sw.) The species are found in Africa. (Sw.)

Zanclostomus.—Bill much compressed throughout, gonys curved downwards, culmen and upper mandible greatly curved, and the basal margin considerably dilated; wings, tail, and feet, as in the last genus, but the lateral fore toes nearly equal. Found in the tropics of the Old World (Sw.). Example, *Zanclostomus Javanicus*, *Phœnicophaus Javanicus* (Horsf.). Java.

Coccyzus (Vieillot).—Bill moderate, thickened at the base, compressed; gonys straight; basal margin of the upper mandible not curved outwards, and scarcely dilated; tarsus and middle toe of equal length; lateral toes unequal. Natives of America only. This genus haunts the branches of lofty trees, from which it collects the insects which form its food.

C. Americanus is described by Yarrell as an occasional visiter in Great Britain. He records four captures of this bird.

Mr. Swainson places the Coucals of India and Africa under the new sub-genus *Leptourus*.

Ptiloleptus.—Wings very long; bill intermediate in form between *Coccyzus* and *Centropus*; nostrils long and linear; feathers of the head and neck slender and rigid; tarsus and middle toe equal, lateral toes unequal, all the claws curved and of equal size; tail-feathers eight. Habits terrestrial. The species inhabit South America. Example, *Ptiloleptus cristatus*. (Sw.)

Centropus (Illiger).—Bill strong; tarsus and middle toe equal; anterior claws slender, slightly curved; hinder claw very long and nearly straight. Native of Africa. Example, *C. Senegalensis*. Mr. Salt, in his 'Travels,' notices this bird as common in the mountainous districts (Abyssinia), generally sitting in the thick caper and thorny bushes, whence it is difficult to drive it.

The *Crotophaginæ*, or Horn-Bill Cuckoos, consist of the following genera:—

Crotophaga. [CROTOPHAGA.]

Dasylophus.—Bill rather large and compressed throughout; gonys angulated; culmen convex, gradually arched; frontal feathers incumbent and concealing the nostrils; feathers before the eye erect, forming a double crest. (Sw.) Example, *D. superciliosus*. (Sw.)

Phœnicophaus (Vieillot).—Bill large, very thick, smooth, resembling that of a toucan in miniature; face naked; nostrils basal, oval, close to the gape, placed in a groove of the bill, and defended by stiff erect bristles. (Sw.) Example, *P. viridis*.

The *Crotophaginæ* are found in Africa and America.

The *Leptostominæ*, or Long-Billed Cuckoos, consist of the following genera:—

Saurothera (Vieillot).—Bill lengthened, longer than the head, and straight, except towards the tip; the culmen convex, the gonys straight, the upper mandible with its margins finely crenated; orbits naked; wings moderate, second and third quills longest; feet short. Example, *S. velata*.

Anadænus.—General structure of *Saurothera*; but the upper mandible is only notched at the tip, the margins are entire; wings much rounded, the first four quills graduated. (Sw.) Native of India. Example, *A. rufescens*.

Leptostoma.—Bill very long and entire; wings very short and rounded; tail long and cuneated; tarsus much longer than the toes. Example, *L. longicauda*.

Mr. Swainson considers *Leptostoma* to be the grallatorial type of the *Cuculidæ*. *Centropus* he also considers to be a grallatorial type.

The *Leptostominæ* are found in India and America.

CUCULINÆ. [CUCULIDÆ.]

CUCULLUS. [ACALEPHÆ.]

CUCUMBER, the name of the fruit of *Cucumis sativus*. [CUCUMIS.] For its culture and varieties see CUCUMBER, in ARTS AND SC. DIV.

CUCUMBER, SPIRTING. [MOMORDICA.]

CU'CUMIS, a genus of Plants belonging to the natural order *Cucurbitaceæ*, comprehending the Melon, the Cucumber, and some sorts of Gourd. It is distinguished from the neighbouring genera by its three thick split stigmas, and by the seeds having a thin margin. The fruit is in all cases pulpy internally, many-seeded, and divided into three or six cells when young. The following are the principal species:—

C. Melo, the Melon. The native country of this valuable plant is unknown. Linnæus says Tartary, but his authority is not given, and in all probability is erroneous; De Candolle says Asia; Roxburgh only knew it in a cultivated state in tropical India; and Professor Royle seems unacquainted with any wild station for it in the Himalaya regions. Cashmere is the most likely to be the country whence it sprang; for it seems to be the mother of many of our other cultivated fruits, and has from time immemorial been famous for the excellence and abundance of its melons, which form a staple article of the food of the inhabitants. For the varieties and cultivation of this fruit see MELON, in ARTS AND SC. DIV.; we only here observe that all the melons known in Europe belong to the present species, unless it be the Winter Melon and its varieties, and that kind possibly originates from the following species:—

C. utilissimus, an annual, native of the higher cultivated lands of India, but generally found in a cultivated state. "The stems exactly as in *C. sativus*, but not quite so extensive. Tendrils simple, leaves broad-cordate, generally more or less 5-lobed; lobes rounded, toothletted; above pretty smooth, below scabrous, the largest generally about six inches each way. Floral leaves of the female flowers sessile, and very small. Male flowers axillary, peduncled, crowded, but opening in succession. Female flowers axillary, peduncled, solitary, both sorts yellow, about an inch or an inch and a half in diameter. Fruit fleshy, generally a very perfect oval; when young, downy and clouded with lighter and darker green; when ripe perfectly smooth, variegated with deeper and lighter yellow; from 4 to 6 inches long, and from 3 to 4 inches in diameter. This appears to me to be by far the most useful species of *Cucumis* that I know. When little more than one-half grown the fruits are oblong and a little downy; in this state they are pickled; when ripe they are about as large as an ostrich's egg, smooth and yellow; when cut they have much the flavour of the melon, and will keep for several months if carefully gathered without being bruised and hung up; they are also in this state eaten raw, and much used in curries by the natives. The seeds, like those of other cucurbitaceous fruits, contain much farinaceous matter blended with a large portion of mild oil. The natives dry and grind them into a meal, which they employ as an article of diet; they also express a mild oil from them, which they use in food and to burn in their lamps. Experience as well as analogy proves these seeds to be highly nourishing, and well deserving of a more extensive culture than is bestowed on them at present. The powder of the toasted seeds mixed with sugar is said to be a powerful diuretic, and serviceable in promoting the passage of sand or gravel. The cultivation of this species is chiefly confined to the Guntoor Circar, where the seeds form a considerable branch of commerce; they are mixed with those of *Holcus Sorghum*, or some other of the large culmiferous tribe, and sown together; these plants run on the surface of the earth, and help to shade them from the sun, so that they mutually help each other. The fruit keeps well for several months if carefully gathered and suspended." (Roxburgh, 'Flora Indica.')

C. sativus, the Cucumber, has rough stems bearing tendrils; leaves cordate, obscurely 5-lobed, petiolate, the terminal lobe the largest; flowers on short peduncles, usually 3, of a yellow colour; the fruit is long, somewhat triquetrous, smooth or prickly, usually shining. When very young the Cucumber is known by the name of Gerkin. Tartary is assigned to this species as its native country, but upon authority equally questionable with that for the Melon. No modern traveller seems to have found it wild. [CUCUMBER, in ARTS AND SC. DIV.]

C. Colocynthis, the Colocynth Gourd. This plant furnishes the drug Colocynth, so well known for its purgative properties. It is found wild in the Grecian Archipelago, Egypt, and the north-eastern parts of Africa generally. Burckhardt saw it covering large tracts in Nubia, and Roxburgh speaks of it as common on the coast of Coromandel. It is doubtful however whether the plant of the latter botanist is not rather *C. Pseudo-Colocynthis*. This species grows like a cucumber, but has cordate-ovate many-cut and lobed leaves, white beneath with hairs. Its fruit is small, round, deep yellow, smooth, hard externally, with an intensely bitter pulp. The gourds are gathered in autumn, when they are beginning to turn yellow; they are then peeled and dried rapidly in stoves. [COLOCYNTH, in ARTS AND SC. DIV.]

C. Citrullus, the Water-Melon. Its deeply-lobed and gashed leaves, and its round fruit, with a spotted rind and a cold watery pink or white flesh, in which lie a number of black seeds, sufficiently mark this species, which is most extensively cultivated all over India and the tropics of Africa and America, and generally in hot countries, but which is of no value in the north of Europe, where high flavour is required more than cooling properties. This plant serves both for food, drink, and physic to the Egyptians. It is eaten in abundance during the season, which is from May to July. It is the only medicine the common people use in ardent fevers: it is gathered when ripe or almost decaying; the juice is expressed, and mixed with sugar and rose-water. It is generally considered to be the Melon of the Jews mentioned in many parts of the Bible.

The other species are of little moment compared with the preceding; many are eatable, but they are in all respects inferior in quality and size. *C. Dudaim* is sometimes grown under the name of Queen Anne's Pocket Melon, but it is a mere curiosity.

CUCUMITES, a genus of Fossil Plants, from Sheppey. (Bowerbank.)

CUCURBITA, a genus of Plants belonging to the natural order *Cucurbitaceæ*. It has monœcious flowers; a campanulate yellow corolla, the petals joined together and to the calyx. In the male flowers the calyx is hemispherically campanulate. The stamens 5, in three bundles, or joined at the apex; anthers abruptly curved both at the base and the apex, the rest straight and parallel. In the female flowers the calyx is obovate clavate, narrowed towards the top or campanulate, and always circumcised under the limb after flowering; the anthers usually sterile; stigmas 3, thickish, and 2-lobed; fruit 3-5-celled; seeds ovate, compressed, with hardly tumid margins.

C. maxima, the Common Large Gourd, has cordate leaves, very rugged hispid petioles; the tube of the calyx obovate, ending in a short neck; fruit globose, somewhat depressed, yellow, red, or green. The native country of this common plant, as well as that of its many varieties, is unknown.

C. Melopepo, Squash Gourd, has cordate obtuse leaves, somewhat 5-lobed; denticulated tendrils, usually transformed into very imperfect leaves; the calyx hemispherically campanulate, short, having the throat much dilated; the fruit depressed; carpels irregular, rising beyond the throat of the calyx; the flesh dry, spongy, and white. The fruit is flattened at both ends. It is of great use in long voyages, for it can be kept for several months in a fresh state, and is commonly made into pies like the pumpkin, or boiled and eaten with meat instead of turnips or potatoes.

C. Pepo, Pumpkin, has cordate obtuse leaves, somewhat 5-lobed, denticulated, the calyx ending in a neck beneath the limb; fruit roundish or oblong, and smooth. It is a native of the Levant. This is the Melon or Millon of the early horticulturists, the true melon being formerly distinguished by the name of Musk-Melon. Though often grown in gardens for curiosity, it is cultivated in many country villages in England on dunghills, with the shoots trained a great length on the grass. When the fruit is ripe a hole is often cut in the side, the seeds taken out, and the space filled with apples, sugar, and spice; the whole being baked is then eaten with butter. On the Continent the fruit is a good deal used in soups, and also stewed or fried in oil and butter. Pumpkin pie is also very common in many parts of the world. There are various receipts given in cookery-books for dressing this fruit so as to render it a palatable and wholesome article of diet.

C. aurantia, the Orange-Gourd, is rather more tender than the other species. Its native country is unknown. It has hitherto only been cultivated for curiosity. When trained spirally round a pole or against a wall, and loaded with yellow fruit, it is very ornamental.

C. ovifera, Egg-Bearing Gourd, or Vegetable Marrow, has cordate angular leaves, 5-lobed, denticulated, pubescent; the calyx obovate, ending in a short neck, and cut round after flowering to the neck. It is a native of Astrakhan. The herb and flowers are very like those of *C. Pepo*, but less scabrous. This fruit is useful for culinary purposes in every stage of its growth. When young it is good fried with butter; when larger, or about half grown, it is excellent either plain boiled or stewed with a rich sauce; in either case it should be cut in slices. The flesh has a peculiar tenderness or softness, from which circumstance it received its name; and this property remains till it is almost fully grown, when it is used for pies.

C. Lagenaria, Common Bottle-Gourd (*Lagenaria vulgaris* of Seringe), is a musky-scented plant clothed with soft pubescence; the stems climbing; tendrils 3-4-cleft; leaves cordate, nearly entire; the flowers monœcious, stellate, spreading much in fascicles; the fruit is pubescent, but when mature quite smooth; the flesh white and edible. It is a native within the tropics. The fruit is shaped like a bottle; when ripe of a pale yellow colour; some nearly six feet long, with a roundish bottom and a neck; the rind becomes hard, and when dried is capable of containing water. It is then of a pale bay colour. It is very important that these bottles should be well and repeatedly washed out, so as to remove all traces of a bitter principle in which they abound, which is poisonous. It is said that a sailor was poisoned some years since by drinking beer out of one of these bottles which had been improperly prepared. Professor Royle also mentions, upon good authority, that cases of poisoning have occurred from eating the bitter pulp of this plant, in which the symptoms were those of cholera.

There are about nineteen species of this genus: they are propagated from seeds.

CUCURBITA'CEÆ, *Cucurbits*, the Cucumber Tribe, a natural order of Plants. It consists of climbing or trailing species with unisexual flowers, scabrous stems and leaves, a lobed foliage, and a more or less pulpy fruit with parietal placentæ. Nearly all the species climb by means of tendrils. The greater part consists of annuals, either wholly, or in so far as their stems at least. The petals are deeply veined, and usually either yellow, white, or green.

The order abounds in useful or remarkable plants, comprehending as it does the Melon, Gourd, Cucumber, Colocynth, Bryony, and all the many species approaching those types. Professor Royle, in his valuable 'Illustrations,' remarks that "they are chiefly remarkable for the power of adapting themselves to the different situations where they may be grown. Thus we hear of their affording large and juicy fruit in the midst of the Indian Desert, where water is 300 feet from the surface (Elphinstone); and they are equally grown in the dry season on the sandy islands of Indian rivers; but excess of moisture does not appear to be injurious, as the great majority are successfully cultivated in the rainy season; and Mr. Moorcroft describes an extensive cultivation of Melons and Cucumbers on the beds of weeds which float on the lakes of Cashmere; they are similarly cultivated in Persia and in China. ('Hort. Trans.,' 2nd ser., vol. i. p. 468, and Staunton's 'Embassy.') Being chiefly annuals which a few months suffice to bring to perfection, we find them succeeding in the summer temperature of northern climates, and thus extending from the line to 55° or 60° of northern latitude, and southwards to the Cape of Good Hope. Some of the species may be seen in the most arid places; others in the densest jungles. Planted at the foot of a tree, they emulate the vine in ascending its branches; and near a hut they soon cover its thatch with a coating of green. They form a principal portion of the culture of Indian gardens: the farmer even rears them in the neighbourhood of his wells."

The affinities of this order are with *Datiscaceæ* and *Begoniaceæ*. There are 56 genera and above 270 species.

Momordica Balsamina.

1, a sterile flower; 2, a fertile flower; 3, a section of a seed; 4, the embryo.

Two principles especially deserve attention in this order; the one saccharine and nutritious, the other bitter, acrid, and purgative; and the qualities of the products of the species vary according to the preponderance of the one or the other. In the Melon, the Gourd, and their allies, the first exists almost exclusively, and hence the edible nature of their fruit; but even here its well-known laxative quality sufficiently attests the presence of the bitter principle in some degree. In the Colocynth, the Bottle-Gourd, various species of Luffa, Bryony, and others, the bitter principle is found in a state of concentration, and hence the active and even dangerous qualities of those plants, from which the Cucumber itself is not exempt: only its bitterness is destroyed by the peculiar cultivation of that plant. The seeds of some kinds yield oil; and those of *Cucumis Momordica* are said to be ground into a kind of meal. [CUCUMIS; CUCURBITA; BRYONIA; MOMORDICA.]

CUDDEN. [MERLANGUS.]

CUDWEED. [FILAGO.]

CULEX. [CULICIDÆ.]

CULICIDES (Latreille), a family of Dipterous Insects of the section *Nemocera*. It has the following characters:—Proboscis long and slender, projecting forwards, usually straight, terminated by two little lip-like appendages; sucker composed of six slender bristle-like members; palpi 5-jointed, generally elongated; antennæ filiform, covered with hairs—in the male sex resembling little plumes; eyes contiguous; no ocelli; wings inclined, lying close to the body when at rest, and having one marginal and two sub-marginal cells.

The *Culicides*, according to Latreille, constitutes the first family of Dipterous Insects, and is the same group as that designated by Linnæus *Culex*. It is divided into three genera, distinguished principally by the following characters:—

Anopheles (Meigen.)—Palpi equal in length to the proboscis in both sexes.

Culex.—Palpi of the males longer than the proboscis, and in the females very short.

Ædes.—Palpi shorter than the proboscis in both sexes.

We are but too well acquainted with the torment inflicted by the insects of this tribe, which are known in this country by the name of Gnats; are called in France Cousins; and in America Mosquitoes.

The pain and irritation are caused by their piercing the skin to feed upon the blood (by means of the little bristles forming part of the proboscis), and injecting at the same time a poisonous fluid. It is said the females alone are the persecutors.

The humming noise accompanying their flight is produced by the vibration of their wings. Gnats seldom appear during the day-time, except in thick woods, and they always abound most in damp situations, a circumstance owing to the habits of their larvæ, which reside in stagnant waters.

The female Gnat deposits her eggs (which amount to 200 or 300 in a year) one by one: and as they are deposited they are joined together, and form a little raft, which floats on the surface of the water. The eggs are hatched in about three days' time, and produce little greenish larvæ, which have a distinct head and lengthened body, composed of numerous segments. The head is furnished with two ciliated organs, which are in constant motion. This motion appears to be for the purpose of creating a current, by which means minute animalculæ, or other substances which may constitute the food of the animal, are drawn into the mouth. Two other appendages, furnished with tufts of hair, appear to co-operate with the former for this purpose.

The breathing apparatus of the larva consists of a tube, terminated by radiating setæ situated at the apex of the body; through this tube the air is conveyed to the tracheæ, and for this purpose it is brought to the surface of the water, so that the animal is then in an inverted position. There is another apparatus also, situated at the tail of the animal, opposed to the breathing apparatus, which serves as a fin, and enables the larva to swim and dive with considerable velocity.

These larvæ are full grown in about fifteen days' time; they next assume the pupa state; the animal then appears to have a rounded form, owing to the apex of the body being recurved. It still inhabits the water and is active; the position of its breathing apparatus is however altered, it being now situated on the anterior part of the body, and consists of two little tubes, which, as before, are applied to the surface of the water for the reception of air. When about to assume the imago state, the skin which covered the pupa being loosened from the animal within, and the space between the two being occupied with air, it floats upon the surface of the water; the Gnat breaks through the upper part, and stands on the skin it has quitted, and which now serves as a little boat, upon which it floats until it has attained strength to fly.

Culex pipiens (Linn.), the Common Gnat, is less than a quarter of an inch in length; the palpi and antennæ are brown; the thorax is of a yellowish brown, with two darker lines; the abdomen is of a pale gray colour; the legs are brown, and the base of the thighs yellowish.

The insect which is so troublesome in the West Indies, the Mosquito (*Culex Mosquito*), is not quite so large as the Common Gnat. Its proboscis is black; the palpi are spotted with white; the head and thorax are spotted with silvery white, and the latter has a curved band of the same hue. The edges of the segments of the body are also of a silver-like colour.

CULM, the stem or straw of grasses.

CULTIROSTRES, a name given by Cuvier and others to a family of Birds, consisting of those species which were united under the genus *Ardea* by Linnæus, and whose bill is large, long, and strong, and most frequently pointed also, such as Cranes, Herons, Storks, &c. [ARDEA.]

CUMBRIAN ROCKS. Professor Sedgwick has given this term to the lowest series of Slaty Rocks which appear in the ranges of Skiddaw and Grasmore Fell in Cumberland. They lie below the green slaty rocks of Scawfell and the Old Man, which the same writer regards as coeval with the strata of Snowdon, and ranks under the title of Cambrian. [CAMBRIAN ROCKS.]

The succession of rocks, as pointed out by Professor Sedgwick in the Cumberland hills, is as follows:—

1. Skiddaw Slate, usually without fossils, but containing *Graptolites* in one locality.

2. Couiston Limestone, abounding in fossils.

3. Coniston Flagstone and Grit.

These rocks find their representatives in those called Cambrian in North Wales. These latter rocks are included by Sir Roderick Murchison in his 'Silurian System.' As the nomenclature of these rocks is still a disputed question, we subjoin the account of them published by Mr. Jukes, in his work on 'Physical Geology.'

"Cambrian or Cumbrian Rocks.—The word 'rocks' is used here instead of 'system,' or 'formation,' because we cannot yet precisely tell the value of the Cambrian division. Cambrian means the rocks of Wales; Cumbrian those of Cumberland and Westmoreland. In Wales these rocks consist of certain thick sandstones, gritstones, and conglomerates, with interstratified beds of green or green and purple slates. It is in the uppermost of the slate beds of this Cambrian group that the great Penrhyn and Llanberris slate quarries are opened. They contain no fossils. These rocks are found to have a thickness of upwards of 20,000 feet in some places in North Wales; but as the base of them is never exposed we know not how much greater thickness they may possess, nor what is below them. One portion of this division has been provisionally called the 'Barmouth and Harlech Sandstone Group.' Their upper boundary is a purely arbitrary line along the top of a certain set of beds drawn by the officers of the Geological Survey of Great Britain, under the direction of Sir H. T. De la Beche, C.B.; their reason for drawing it being simply that no fossils have as yet been found below that line, whereas fossils are pretty abundant in many places above it. It must not be forgotten that Professor Sedgwick (of whose peculiar department we are now speaking, he being the one geologist who has single-handed done far the most to unravel the structure of these older rocks) dissents from this placing of the boundary of the Cambrian Rocks; and himself places it much higher, so as to include the beds we shall subsequently speak of, as Lower Silurian, dividing his system into Upper and Lower Cambrian. There can be no doubt that if we neglect the fossils, and look only to the physical structure and position of the rocks of Wales, Professor Sedgwick is right. There can be no reason for drawing the boundary where it has been drawn, and along no other geological horizon in North Wales, except the fact that fossils have been found in all the rocks above that line of division, and in none of those below. Whether they may not hereafter be found is another question. If we go to Cumberland, Professor Sedgwick there describes the Cambrian, or, as he there calls them, Cumbrian Rocks, as likewise consisting of upper and lower, and gives the following abstract of them:—

		Feet.
Cumbrian, Upper	Coniston Flagstone	1500
	Coniston Limestone	300
	Slates and Porphyry	10,000
Cumbrian, Lower	Skiddaw Slate	6000

He describes these however as all fossiliferous, which, by the rule lately mentioned, would exclude them from being considered as Cambrian at all, more especially as the fossils of the upper beds are such as palæontologists seem agreed to consider of Silurian age. It is highly probable that the Skiddaw Slates are of the same age as the Barmouth and Harlech Sandstone Group of North Wales, which likewise contains the best roofing-slates of that country. In that case, according to the classification adopted by the Geological Survey, the Skiddaw slates would be considered Cambrian, and all above them as Silurian. The reader will see from these statements that this part of the classification of the stratified rocks is far from being settled. There is however no dispute about the things themselves; the rocks are all known, and their order completely ascertained; the uncertainty is merely as to the name by which certain portions of them shall be called." [WALES, GEOLOGY OF, in GEOG. DIV.]

CUMINGIA. [CONCHACEA.]

CUMINUM, a genus of Plants belonging to the natural order *Umbelliferæ*. It has 5 calyx teeth, which are lanceolate, setaceous, unequal, and permanent. The petals are oblong, emarginate, erect, spreading, with an inflexed lobe. The fruit is contracted at the side. The ridges of half-fruits wingless; the primary filiform, minutely muricated, the laterals forming a border, the secondary more prominent and aculeated; the channels under the secondary ridges with one vitta in each. The species are annuals, with multifid leaves, having setaceous divisions. The flowers are pink or white.

CUMMINGTONITE, an American Mineral belonging to the Hornblende series. It is fibrous, of an ash-gray colour, with a slight silky lustre. It is found at Cummington and Plainfield, in Massachusetts. (Dana, *Mineralogy*.)

CUNITA, a genus of Plants belonging to the natural order *Labiatæ*. It has a 13-nerved calyx, ovate, tubular, equal, 5-toothed, the throat villous inside. The corolla having the tube equalling the calyx, naked inside, and the limb bilabiate; the upper lip erect, flattish, usually emarginate; lower lip spreading, trifid, with nearly equal entire lobes, the middle lobe rather the largest and emarginate. The stamens 2, erect, exserted, without any rudiments of the upper two; filaments glabrous, toothless; anthers 2-celled, cells parallel, or at length divaricate. The style shortly bifid at the apex; the lobes nearly equal, subulate, minutely stigmatiferous at top; the achenia dry and smooth. The flowers small, white, or purplish. The species are herbs, shrubs, or undershrubs.

C. Mariana, native of Canada to Carolina, on dry mountains, is a branched herb with short glabrous branches, but pubescent at the nodes. The corolla is about twice as long as the calyx, and is pubescent inside, and of a red colour. It is employed medicinally, where it grows, in slight colds and fevers, with a view to excite perspiration.

C. microcephala is also used medicinally in coughs and colds, in Brazil, where it grows. It has a procumbent stem, with scarcely pubescent branches; the leaves petiolate, oblong or obovate, obtuse, quite entire, or subsinuately serrated, narrowed at the base, glabrous, and flat. The corolla is white; the throat villous inside.

There are several species of this genus, none of which are of any known use except those above mentioned.

CUNNINGHAMIA, a genus of Plants belonging to the natural order *Coniferæ*. *C. Sinensis* is an evergreen Chinese tree, formerly called *Pinus lanceolata*. It has narrow oval lanceolate stiff pungent leaves, which, when the plant is old enough, collect into cones, after the manner of an *Araucaria*. The plant will live near London in the open air, with a little protection in winter.

CUNONIA'CEÆ, *Cunoniads*, a small natural order of Polypetalous Apocarpous Exogens, allied to *Saxifragaceæ*, with which they were formerly united. They are trees or shrubs, inhabiting Southern Africa, South America, and very sparingly the East Indies. In most respects their flowers are constructed like those of *Saxifragaceæ*, but the styles are more consolidated, and they have a dense spiked or racemose inflorescence instead of a few loosely-arranged blossoms. The leaves are opposite, and furnished with interpetiolar stipules, and being pinnated, in most cases give the plants a peculiar aspect. Little is known of their properties, except that their bark is sometimes very astringent, and used for tanning purposes. There are 22 genera and 100 species.

C. Weinmannia rubescens.

1, a perfect flower; 2, an ovary; 3, a transverse section of the same; 4, a ripe fruit.

CUPRESSINITES, a genus of Fossil Plants from Sheppey, containing 13 species. (Bowerbank.)

CUPRESSOCRINITES, a genus of *Crinoïdea*. (Goldfuss.)

CUPRESSUS, a genus of Plants belonging to the natural order *Coniferæ*, distinguished from the firs and pines by its leaves being mere scales, its cones formed of a small number of peltate woody bracts, and the seeds very small, angular, and several to each bract. Botanists mention several species, but of these three only are suited to the climate of Great Britain.

C. sempervirens, the Common Upright Cypress, is a native of the warmer parts of Europe, but has long since been transferred to gardens for the sake of its deep evergreen branches and leaves, and the gloomy air it imparts to the situations which it occupies. Its timber is of great durability: it is probable that Gopher-Wood, which some have referred to the cypress, was rather the timber of *Thuja articulata*. It is not much cultivated in England, the climate being too damp and cold for it in summer; otherwise it is sufficiently capable of resisting the cold of winter. Its formal mode of growth moreover is not to the taste of the people of this country. The cypress was anciently, as well as at present, in south-eastern Europe, chosen as a memorial of the dead; and they are still the principal ornaments of cemeteries in Greece and all over the Ottoman empire.

C. horizontalis, the Spreading Cypress, is a far handsomer species, partaking in all the excellent qualities of the last, being more hardy, and becoming a beautiful object with its graceful spreading branches, loaded, as they usually are, with large round cones. Miller has rightly pointed out the difference between this and the last, but it is nevertheless exceedingly uncommon in the collections of this country. The Spreading Cypress of the nurseries is nothing but a very slight variety of *C. sempervirens*.

C. Lusitanica, the Cedar of Goa, differs from the two preceding in its much freer mode of growth, and in its leaves having a singularly glaucous colour. It is said to be of Indian origin, but has long since been naturalised in Portugal, where about Cintra it acquires a large size. In England it will only succeed well in the warm parts of the southern coast.

CUPULE, a kind of cup or involucre surrounding certain kinds of fruit, and composed of bracts more or less grown together. In the oak the cup of the acorn is the cupule; in the hazel-nut it is the husk; in the beech and chestnut the prickly shell; and in the hornbeam the lobed bract.

CUPULIFERÆ. [CORYLACEÆ.]

CUPULITES. [ACALEPHÆ.]

CURASSOW. [CRACIDÆ.]

CURCU'LIO, a genus of Insects founded by Linnæus for such Tetramerous *Coleoptera* as have club-shaped antennæ inserted on a prolonged rostrum. In the twelfth edition of the 'Systema Naturæ,' 95 species are enumerated. The progress of entomology has converted the genus, as defined by its founder, into a family including several thousand species, though the original name is retained for a few South American beetles, of which *Curculio splendidus* is the type. The popular name for these insects, whatever may be their scientific designation, is the Weevil. The Weevils are favourites with the entomologist on account of the sigularity and often beauty of their forms and colours. The splendid Diamond Beetle, the wing-cases of which furnish such gorgeous microscopic objects, is a member of the tribe. Many of them are adorned with the most vivid metallic lustre, and some in intensity and brightness of hue emulate gems, and have been used for purposes of ornament. The family includes very numerous genera and species, and they are distributed widely over the world.

The Weevils are interesting in another point of view. Many of them are dangerous enemies to the agriculturist, destroying grain, fruit, flowers, leaves, and stems, and from their numbers often perpetrating serious mischief. Their natural history therefore has been made an object of special researches, in the hope of counteracting their ravages. We shall here give some account of the noxious species.

1. Weevils attacking the nutritive organs of plants.—*Rhynchites Betuleti* is a little blue or green beetle, glossed with metallic lustre, which attacks the vine and the pear-tree. It is four lines in length, one-third of which is occupied by its snout. Short spines on the thorax distinguish the male from the female. It attacks the leaves of the plants mentioned, in order to construct its habitation of them, and with a view to their furnishing food for its offspring. It rolls up the leaves and deposits its eggs in the rolls, where they are hatched, the nest afterwards supplying the larvæ with food. As the maggot grows, the rolled leaf and its stalk dry up, and at length fall to the ground on the first high wind, by which time the maggot is fully grown and ready to leave its house, to bury itself in the ground and wait for the spring, when it is to appear in a new garb as a Weevil.

The process by which the roll is made is thus described by Köllar: "When the female has selected a suitable leaf, she cuts the petiole with her rostrum almost half through, so that it hangs down, and is more conveniently placed for future proceedings. She then begins to roll the leaf together, generally alone, but sometimes assisted by the male. While this operation is going forward, she also lays her eggs, that is, she pierces the roll, lays an egg in the opening, and pushes it in with her rostrum, in such a manner that it remains on the inner side of the leaf. When she has introduced five or six eggs in this manner, between the different folds, she rolls the remaining part of the leaf entirely together, so that it is impossible to discover, from the outward appearance, in what manner the eggs were deposited." This beetle is extremely injurious to vineyards by defoliating the vine, after which the grapes will not ripen, and the prospect of a vintage is destroyed. The rolled-up leaves containing its young should be carefully collected and destroyed before the worms have time to arrive at maturity. Its operations are often erroneously ascribed to *R. Bacchus*. *Otiorhynchus sulcatus* is another beetle which is injurious to the vine by gnawing off the young shoots. It also attacks the roots of succulent plants.

Nemoicus oblongus is a little Weevil only two lines long, with a very short beak, a black head, body, and thorax; and reddish antennæ, feet, and wing-cases. It attacks the young leaves of young fruit-trees, above all those of the peach, and is both a glutton and an epicure; for while it devours most voraciously, it selects only the delicate portions of the leaf, the cellular parenchyma, leaving the midrib and petiole untouched. It appears very early in spring, and after pairing the female deposits her eggs in the ground, the grub feeding on the roots of various plants until the following spring. When these insects are on the trees, they must be gathered with the hand.

There is a very small species of *Rhynchites*, the *R. Alliariæ*, scarcely a line and a half in length, and of a steel-blue or green colour, which, by injuring the shoots of young trees and fine grafts, is a source of great annoyance to the planter, sometimes perpetrating great ravages in nurseries, without distinction as to the kind of trees. The following interesting account of the operations of this insect is extracted from Köllar:—

"When the shoot of the tree or graft is about a span long, the female selects one that suits her, and it does not signify to what kind of fruit-tree it may belong. As soon as she has reached the most suitable part of the shoot, she marks the place first by a prick or by a small cut, where she intends to cut off the bud or shoot. She then recedes about a line upwards, and begins (with her head turned downwards), on the side which is not next the tree, to bore with her proboscis, until she reaches the middle of the shoot. With it she also widens the chamber, and prepares it for her offspring. She then places herself over the entrance, and lays an egg, which is pushed in by the proboscis and conveyed to the proper place. This operation lasts an hour. Immediately after the female returns to the former place, to cut off the shoot, moving it from one side to the other with her proboscis, until she has cut it a certain depth. She then gives some decided thrusts, which she continues, without fatigue, till the shoot only hangs by the under part. When she observes this, she gets up on the point of the twig, to make it fall over by her own weight. It not unfrequently happens that it falls immediately, the shoot having been previously so cut as to remain attached to the stem only by the bark. If the beetle however finds that the pierced shoot does not fall, she turns back to labour again at the same place, and cuts still deeper through the branch; and if she is not able to divide it, she gets up once more to the further extremity, by which means she generally succeeds in bringing the separated branch to the ground. When this labour is over, she feeds upon a leaf, scraping off the epidermis, which serves her as food." This operation is repeated day after day for the same purpose until the middle of June, at the rate of two eggs a day, the insect reposing under a bent leaf at night. Her work is interrupted by bad weather. When the egg is hatched, usually in eight days, the grub eats the pith of the shoot which falls off, upon which it leaves its habitation, and buries itself in the earth, where it makes a subterraneous vault for its winter residence. When the spring comes, it appears as a Weevil to pursue the avocations above described. The beetle is timid, and drops from the leaf when approached, so that, when we proceed to gather them, which should be done in order to destroy them (besides collecting and destroying all fallen and injured shoots where their eggs may be), we must approach with caution to gain our object.

There are two species of Weevil which attack the wood of the pine-tree, namely, the *Hylobius Abietis* and *Pissodes notatus*; the first is the larger species, and usually precedes the latter in its attacks. When the one is plentiful, the other is also abundant, and vice versâ; the cause of this correspondence in numbers being, that they usually only attack such trees as are sickly, but when the supply of sickly trees fails, they are apt to have recourse to the more healthy plants, and thus may destroy valuable plantations. They apparently attack sickly trees in preference, since in such the motion of the sap is sluggish, and there is not so much resin exuded as to oppose and impede their operations. The larger insect attacks both bark and buds, and dangerously wounds such ramifications of the roots as are near the surface of the ground. The wound is an ugly bean-shaped scar. The second species chiefly confines its attacks to the bark and sickly cones. The wounds it makes resemble pin-holes, and are often extremely numerous. On account of their caution and timidity, both these insects, although numerous when present, are very difficult to find. The best preventive of their ravages is to root up and burn such young trees in the plantation as are sickly.

There is a species of *Calandra*, the *C. Palmarum*, which in South America attacks the pith of the palm-tree. Its larva is called by the colonists Ver Palmiste, and is esteemed a delicacy.

In the third volume of the 'Journal of the Royal Agricultural Society of England,' Mr. Curtis has given an account of two little Weevils, *Ceutorhynchus assimilis* and *C. contractus*, which injure turnip crops by puncturing the leaves of the young turnips, sometimes causing as much damage as the Turnip-Fly (*Haltica Nemorum*). They should be collected from the turnip-flowers left for seed, by shaking the stalks over a bag-net or cloth, and sweeping the insects into a pail of lime and water. The insects should afterwards be destroyed by boiling, as the hardness of their horny coat renders it no easy matter to destroy them otherwise.

2. Weevils attacking the reproductive organs of plants.—There is a little brown Weevil which often destroys our prospects of a plentiful supply of apples. As soon as the spring comes it goes forth to seek the apple-tree, and when the blossom-buds appear, and are full of sap, it deposits its eggs in them, so that the grubs are hatched in the first warm weather, and immediately proceed to destroy the generative organs of the plant, eating up the innermost first. It is called *Anthonomus Pomorum*. The affected flowers swell out, and form a sort of cup, within which, when we open them, we find the larva in the form of a small white maggot with a black head. The beetle selects the finest apple-blossoms to be the cradles of its offspring. It bores a hole in them with its proboscis, making a canal even to the parts of fructification; then laying its eggs at the entrance it turns round and pushes them in with its snout as far as it can. This operation it repeats as long as it has eggs to lay, walking from blossom to blossom, choosing the finest and calmest days for its labours. Nothing but gathering the beetles and destroying the affected flowers can arrest their progress in the orchard, and by doing so we may diminish their number, though, it is to be feared, hopes of their extirpation are vain.

There is another Weevil of the same genus, the *A. Pyri*, very similar in appearance, which destroys both blossom and leaf-buds of the pear, and which, when not too numerous, may even increase the crop by preventing an overweight of fruit. The ascent of both these beetles up the trunks of the trees may be impeded by circles of paper covered with tar.

The fruit of the plum is destroyed by a Weevil called *Rhynchites cupreus*, which sometimes also makes use of the soft spring shoots of plum and apricot trees. The female beetle attacks the plums when they are about the size of almonds. She has two objects in view: first, to deposit her egg in the pulp; and second, to sever the fruit from the tree in order that the larva may bury itself in the earth preparatory to its final metamorphosis. The first purpose she effects by cutting the epidermis with her proboscis, raising it, boring a hole in which her egg is to be laid, and after that has taken place covering it carefully over with the raised skin so as to prevent the access of water. Before she sets about this, she half cuts through the peduncles; and when the egg-laying operation is completed she severs the stalk entirely; the joint operations occupy from two to three hours. It takes the grub five or six weeks to devour the pulp of the plum. If left undisturbed, the beetle never leaves the tree until it has pierced and thrown down every plum it can find. The only remedy or preventive to its destructive industry is to gather and destroy the affected plums. Similar ravages are committed on the apple by another species of *Rhynchites*, *R. Bacchus*, the hue of which is beautiful purple and gold.

In the first volume of the 'Transactions of the Entomological Society,' Mr. W. Christy has made known a Weevil, the *Calandra Tamarindi*, which destroys tamarind stones. There are sometimes thirty or forty of these Weevils in a single stone. He was led to seek for them from finding that the stones of tamarinds sometimes crumbled to pieces in the mouth. In such cases the albumen was perforated in every direction, and the cavities filled with a brownish powder. Those in which he first found the insect exhibited no trace of puncture in the epidermis. It would be curious to ascertain in what manner the parent insect deposits her eggs. If she attacks the fruit in an advanced state she must have to make her way through the external shell, the internal acid pulp, and the leathery envelope of the inside, before arriving at the stone itself.

A more destructive species of *Calandra* is the Corn-Weevil, *C. granaria*. In this case the maggot also is found in the centre of grains without trace of an aperture. The insect probably lays the egg in the blossom. It is often very abundant in old granaries. The bread made from the affected flour is supposed sometimes to be unwholesome. Perfect ventilation and a constant shifting of the grain are the best remedies. Mr. Mills states ('Ent. Trans.' vol. i.) that a heat of 110° Fahrenheit did not prevent the development of the insect, whilst from 130° to 140° killed them.

The *Bruchus granarius* attacks peas and beans, selecting the finest seeds in which to deposit her eggs. The bean- and pea-fields in Kent suffer sometimes severely from this beetle. It is a little black punctured species, gray beneath, with legs of the same colour. *B. Pisi*, a larger species, common in peas from Germany and Russia, is in North America at times such a pest, that in some States, towards the beginning of the last century, the cultivation of peas was abandoned in consequence of its ravages.

The family of *Curculionidæ*, as at present constructed, has been made the subject of special research on the Continent by M. Schönherr, and in England by Mr. Walton. The former entomologist has published a work entitled 'Genera et Species Curculionidum.'

CU'RCUMA, a genus of Plants belonging to the natural order *Zingiberaceæ.* It has the tube of the corolla gradually enlarged upwards; the limb 2-lipped, each lip 3-parted; the single filament broad; the anther incumbent, with two spurs at the base; the style capillary; the capsule 3-celled; the seeds numerous, arillate. The species are stemless plants with tuberous roots; the flowers are of a dull yellow colour, surrounded by bracteolæ.

C. Zerumbet, Zedoary, has lateral spikes, the tubers palmate, pale straw-coloured; the leaves from 4 to 6 together, with a long somewhat winged petiole, with a dark purple cloud running down the centre; the flowers shorter than the bracteolæ; the embryo truncate, nearly as long as the seed, the upper half lodged in the vitellus, the lower half in the perisperm. This plant is the *Zedoaria longa* of the shops, and has the same property as the following species. It is a native of the East Indies and Java.

C. Zedoaria, Broad-Leaved Turmeric, has the spikes lateral; biennial tubers, which are yellow internally; the leaves petioled broad-lanceolate, entire, underneath covered with soft sericeous down. This is the *Zedoaria rotunda* of the shops. Fée has confounded this plant with *Kæmpferia rotunda,* which has no sensible properties resembling the plant in question. The tubers of this plant are aromatic, and are used by the Hindoos not only as a stimulating condiment and a medicine, but as a perfume. Its sensible properties are very like those of ginger, but not so powerful. It is employed in the East in cases of disease, as colic, cramp, torpor, &c., where stimulants are indicated. The Zedoary is used under the same circumstances. The roots of both these plants are imported into Europe, but are not used extensively. *C. Zedoaria* is a native of Bengal, China, and various other parts of Asia, and of the Asiatic Islands.

C. rubescens has lateral spikes, the tubers pearl-coloured inside; the leaves bifarious. broad-lanceolate, cuspidate, smooth, strongly marked with parallel veins, of a uniform dark green with the nerves or ribs red, 12 to 24 inches long, 5 or 6 inches broad; the scapes invested with several dark reddish sheaths. It is a native of Bengal. All the parts of the plant have a pleasant aromatic smell when the plant is bruised. The pendulous tubers of this and several other species of *Curcuma* yield starch, and are employed by the natives for preparing arrow-root. In Travancore it forms the principal diet of the natives.

C. Amada, Mango-Ginger, has few-flowered central spikes; the tubers horizontal, palmate, of a deep orange colour inside; the leaves radical, bifarious, petioled above their sheaths, lanceolate cuspidate, smooth on both sides, from 6 to 18 inches long by 3 to 6 inches broad. This plant is a native of Bengal, and is called by the Bengalees Amada. It is called Mango-Ginger because the fresh root has the smell of a mango. It is used for the same purposes as ginger.

C. leucorhiza grows in the forests of Bahar, where it is called Tikor. It has remarkably long tubers, often a foot in length, of a pale yellow inside, and they produce an excellent arrow-root.

C. angustifolia, with stalked narrow lanceolate leaves, is a native of the forests of India from the banks of the Lona to Nagpore. Its tubers, which are found at the end of fleshy fibres which meet together forming a crown, yield an excellent arrow-root, which is that met with in the markets of Benares.

C. longa, the common Turmeric, is cultivated all over India, and is used as a condiment and for dyeing. The root is divided into several fleshy fingers, of an oblong form, and as thick as the thumb. The leaves spring at once from the crown of the root, have a lanceolate figure, sheathe each other at the base, are about a foot long, and produce from their centre a short thick leafy spike, in the axil of whose bracts are seated the inconspicuous pale cream-coloured flowers. Dr. Roxburgh gives the following account of the manner in which the plant is cultivated: "The ground must be rich, friable, and so high as not to be drowned in the rainy seasons, such as the Bengalees about Calcutta call Danga. It is often planted on land where sugar-cane grew the preceding year, and is deemed a meliorating crop. The soil must be well ploughed and cleared of weeds, &c. It is then raised in April and May, according as the rains begin to fall, into ridges, nine or ten inches high, and eighteen or twenty broad, with intervening trenches, nine or ten inches broad. The cuttings or sets, namely, small portions of the fresh root, are planted on the tops of the ridges, at about eighteen inches or two feet asunder. One acre requires about nine hundred such sets, and yields in December and January about two thousand pounds weight of the fresh root." [TURMERIC, in ARTS AND SC. DIV.]

CURLEW. [SCOLOPACIDÆ.]

CURRANT. [RIBES.]

CURRUCA, a genus of Insessorial Birds belonging to the tribe *Dentirostres* and family *Sylviadæ.* It includes, according to Yarrell, the following British species:—

Curruca atricapilla, the Black-Cap Warbler.

C. hortensis, the Garden-Warbler.

C. cinerea, the Common White-Throat.

C. sylviella, the Lesser White-Throat. [BLACK-CAP; SYLVIADÆ; WHITE-THROAT.]

CURSORIUS. [CHARADRIADÆ.]

CUSCUTA'CEÆ, *Dodders,* the Dodder Tribe, a small natural order of Monopetalous Exogens, cut off from *Convolvulaceæ* because of their imbricate corolla, which does not fall off after flowering, their seeds with a spiral acotyledonous embryo, and their leafless parasitical habit. There are but two genera of this order, *Cuscuta* and *Lepidanche.* About 50 species have been described.

Cuscuta, Dodder, is a genus met with in most temperate climates, the species fixing themselves on the branches of woody or other plants, twisting round them, striking a number of minute suckers down upon their bark, and thus attracting from the system of the plants and from the air the sustenance necessary to their own support. Hence they are true parasites, although they do not actually, like mistletoe, plunge their roots into the wood and incorporate themselves with the tissue.

Cuscuta Epithymum, twining round Lucerne.

1, a perfect flower; 2, a corolla cut open; 3, an ovary with its calyx; 4, the embryo.

The following are the species of *Cuscuta* found in Great Britain:—

C. Europæa, Common Dodder, a white or reddish-looking annual, which flings its thread-shaped arms like a cluster of living threads round the branches of heath, furze, &c., on commons and dry wastes. It has no leaves, except tiny scales that stand in their room; and it bears small clusters of white bell-shaped blossoms, each of which has five scales at the base of its tube. The fruit is a little membranous capsule, opening transversely like a soap-box, and dropping four seeds upon the soil. There is a common prejudice that these seeds actually strike root into the plant; but that this is a popular error is sufficiently shown by the following observations translated from De Candolle: "The seed of dodder differs from that of other *Convolvulaceæ* by the absence of cotyledons, as the dodder itself differs from them by the absence of leaves; the latter are either entirely absent, or are reduced to almost imperceptible scales. The germination of the dodder is effected, like that of plants in general, in the earth, and without requiring the presence of other vegetables. The embryo, deprived of its cotyledons, is nourished, in its first development, at the expense of the central albumen which it envelops. The slender and simple radicle descends into the earth; and the plumule, equally simple and cylindrical, rises like a thread: if it finds no other living plant near it, it dies; if it finds one, it surrounds the stem, and from the points of contact proceed hollow tubercles or suckers which plant themselves in the bark, and suck the juice which has been elaborated by the plant attacked; then the root becomes obliterated and dies, and the plant lives from that time forward by its suckers only. Whilst it was not a parasite, it rose vertically; as soon as it became one, it was no longer tempted to direct itself either vertically, or towards the light. Its shoots dart from one plant to the other, and thus are conveyed to new victims when the old ones are exhausted. Often the seeds germinate before they quit the capsules, and the new plant immediately becomes a parasite; this is particularly observed in the *Cuscuta monogyna,* which attacks the vines in Languedoc.

"The dodders, called by the French cultivators Teigne, Rache, Perruque, &c., are very dangerous to the fields of leguminous plants which they attack, and upon which they multiply themselves with singular rapidity. They destroy the plants either by depriving them of their nourishment, or by strangling them in their folds. It is difficult to guard against them on account of the rapidity of their vegetation, the facility with which they pass from one plant to another, the abundance of their seeds, and the double power which they possess of germinating either in the earth or in the capsule. M. Vaucher cleared his artificial fields from dodder pretty well by perpetually breaking and dividing their stalks with a rake. The means which appear to me really efficacious are immediately to mow all the portions of artificial meadow where dodder has been seen to develop itself, and to do it before it can have produced seed. If it appear in fields of flax, the plants attacked must be cut down, or rooted up; and if it appear among vines, the branches must be cut before the seed is matured. If these precautions have been neglected, and a portion of the land should be infested with these seeds, the crop which has been attacked must be replaced by crops of corn or of grasses. Thus time is given to the seeds of dodder which have been concealed in the soil, to develop themselves, when they may perish without doing any harm, since the soil finds itself covered with plants which cannot nourish them. As to the seeds of leguminous plants which may be infested by a mixture with those of the dodder, the best means to get rid of them is to sift them in a tolerably fine sieve, so that the seeds of the dodder, which are very small, may pass through, leaving those of the trefoil or of the lucerne. In this operation the seed must be shaken rather violently, so as to break the capsules of the dodder, and to force their seeds out."

C. Epilinum, Flax Dodder, has clusters of bracteated sessile flowers, the tube of the corolla ventricose; scales adpressed, fimbriated, distant below, with rounded spaces; the calyx with fleshy segments, deltoid below, nearly as long as the tube of the corolla. This species is parasitical on flax, and very injurious to the crop.

C. Epithymum, Lesser Dodder, has clusters of bracteated sessile flowers; tube of the corolla cylindrical; the scales converging, as long as the tube of the corolla, fimbriated, and rounded at the end, approximate below, with narrow acute spaces; the calyx bell-shaped, shorter than the tube of the corolla. It is parasitical on small shrubby plants.

C. Trifolii, Clover-Dodder, has the scales converging, half as long as the tube of the corolla, fimbriated and rounded at the end, distant below, with rounded spaces; the calyx narrowed below about as long as the tube of the corolla. It is parasitical on clover.

(Babington, *Manual of British Botany.*)

CUSHAT. [COLUMBIDÆ.]

CUSPARIA. [GALIPÆA.]

CUSTARD-APPLE. [ANONACEÆ.]

CUTICLE. [EPIDERMIS.]

CUTTLE-FISH. [SEPIADÆ.]

CYANITE. [KYANITE.]

CYA'THEA, a genus of Plants belonging to the natural order of Ferns. The sori are globose, situated upon a vein or veinlet, or in the axil of a fork of the vein; the receptacle elevated, globose, or columnar; the involucre globose, inferior, membranaceous, or somewhat horny, at first entire and covering the whole sorus, afterwards bursting from the top with a nearly circular opening, becoming cup-shaped, more or less entire, or laciniated, or lobed; the veins pinnate, simple, or forked, free. (Hooker.) The species are arborescent, and the trunks are often beautifully marked with the scars of the fallen fronds. The fronds are simple or pinnate, or decompoundly pinnate. The stipe is frequently aculeated. The species of this extensive genus of Ferns are found most highly developed in tropical climates. They give a peculiar feature to the vegetation of many districts of South America, and specimens have been brought from the forests of Brazil, the mountains of Mexico and Peru, from the islands of the Eastern, Western, and Southern Oceans, and from the south of Africa and the interior of India and China. Sir William Hooker, in the 'Species Filicum,' enumerates about forty different species. They are difficult to determine when brought to this country. "They have," says Sir William Hooker, "arborescent trunks whose appearance, and even external form, are only known to travellers who have the privilege of seeing them in their native soils. The fronds, gigantic in most cases, and large in all, seldom reach us in an entire state. We are but little acquainted with the stipes, whether it be unarmed or aculeated, or with any other character which may afford marks of distinction. The shape or outline of the entire frond we have rarely the means of ascertaining: nor do we know what is the exact nature of its composition, nor the value to be put upon the more or less downy or scaly covering of the pinnæ, or the greater or less breadth of the pinnæ, or pinnules, or segments, or the more or less deeply serrated margins. Hence, too, their synonymy becomes inextricable; and without the opportunity of examining authentic specimens of authors, their species in many instances must be looked upon as doubtful. The difficulty is increased by the older authors not considering the nature of the fructification nor the venation, so that in few herbaria do we find the most common, and, we presume, the original species, the one upon which the genus appears to have been mainly founded, *Cyathea arborea*, correctly named."

The following is the definition of the typical species:—

C. arborea, Common Tree-Fern, unarmed, or with few distant short prickles on the main rachis and stipes which are frequently downy; fronds bipinnate; pinnules lanceolate, elongate, much acuminated, deeply pinnatifid, glabrous, or with the rachis and costa hairy, paler beneath; involucre coriaceous, cup-shaped in age, a little contracted upwards, opening with a beautifully even margin. It is a native of Jamaica, Hispaniola, Martinique, St. Vincent, probably the West India Islands generally, and Brazil.

In Hooker's 'Species Filicum' the members of this genus are distributed according to the districts in which they grow. Twenty-one species are natives of the West Indies, Mexico, and South America. Two only are found in South Africa. Eleven are natives of Eastern India and islands, the Pacific Islands, and New Zealand.

Few of these Ferns are used by man, and although very elegant are seldom cultivated. One of them, *C. medullaris*, a native of New Zealand, produces a starchy matter, which is used by the natives as food, and called Mamaga. The starch is found in the roots, and these are baked and eaten as food.

(Hooker, *Species Filicum;* Burnett, *Outlines of Botany.*)

CYATHOCRINI'TES, a genus of Fossil *Crinoidea*, confined to the Palæozoic Strata. [ENCRINITES.]

CYATHOPHY'LLUM, a genus of *Madrephyllicea*, which occurs fossil in Palæozoic Strata, especially in the calcareous beds of the Silurian and Carboniferous Rocks. In the works of Goldfuss, Murchison, and Phillips, many species are recorded from the Eifel, Salop, Devon, Yorkshire, &c. [MADREPHYLLICEA.]

CY'BIUM, a genus of Fossil Fishes, from the London Clay of Sheppey. (Agassiz.)

CYCADA'CEÆ, *Cycads*, the Cycas Tribe, one of the natural orders of Gymnospermous Plants. It is essentially characterised by its trunk growing in a cylindrical unbranched manner, in consequence of the development of one terminal bud only, and by its diœcious flowers, of which the males at least grow in cones composed of peltate scales. In one genus, *Zamia*, the female flowers also are disposed in the same manner; in the other, *Cycas*, they are placed upon the toothings of abortive leaves, occupying the centre of the terminal bud. The leaves of these plants are pinnated, and have a certain resemblance to those both of ferns and palms; their wood is arranged both in concentric circles, which in *Cycas* are numerous, and in a confused manner among the central pith; so that a Cycadaceous stem partakes in structure of the peculiarities of both Exogens and Endogens. In the manner in which their leaves unrol, and in their terminal single bud, *Cycadaceæ* resemble Ferns, with which they may moreover be compared on account of their fruit proceeding from leaves; with *Coniferæ* they accord in the cone-like arrangement of their parts of fructification and their naked ovules; and with Palms in the secretion of a large quantity of fæcula in their stem, in their mode of growth, and in the

Cycas circinalis.

1, a male cone; 2, a female spike; 3, a section of a ripe fruit.

arrangement of a part of their woody system. *Cycadaceæ* therefore, belonging as they do to Gymnosperms, possess nearly equal affinity with Palms, or Endogens, and Tree-Ferns, or Acrogens. The species are natives of the tropics and temperate parts of America and Asia. They are found at the Cape of Good Hope and Madagascar, but not in equinoctial Africa. One species, *Macrozamia spiralis*, inhabits the west coast of Australia. Undoubted fossil remains of these plants in the Lias, Wealden, and other formations of England, attest the fact of their once having formed a part of the vegetation of Great Britain. All the species contain starch, and from many it is seperated and employed as an article of diet. The epeciee of *Encephalartos* are called Kaffir-Bread. The seeds of *Dion edule* yield etarch in Mexico. The same substance, under the name of Sago, is obtained from epecies of *Zamia* in the Bahamas and other West India Islands; in Japan from *Cycas revoluta;* and in the Moluccas the *Cycas circinalis* yielde a coarse kind of flour. Thie species also yielde a transperent gum. The order contains about fifty epeciee.

A fine collection of Cycadaceous Plants existe in the Royal Gardens at Kew. A unique collection of these plante has elso been recently made hy the Rev. J. Yetes of Lauderdale House, Highgate.

(Lindley, *Vegetable Kingdom.*)

CYCADEOIDEA. The fossil stems proved by Dr. R. Brown to be of the Cycadeoue family, which occur in the Iele of Portland, were thus named by Dr. Buckland. Brongniart called them *Mantellia*, and they are ranked by Presl as *Zamites.*

CYCADI'TES. Fossil remaine of Plants allied to the natural gronp of the *Cycadaceœ* are thus nemed by various authors, but the species are now usually ranked under *Pterophyllum, Zamites, Otopteris*, &c.

CYCLADIDÆ, a family of Lamellibranchiate *Mollusca*. It is a group of Fresh-Water Mollusks, whose shells resemble thoee of *Kellia* or of *Astarte*, but whose eoft parts present etructures conspicuously distinguishing them from the tribes to which either of those genera belongs.

The shells are more or less tumid, equilateral or inequilateral, thin, as in our British forms, or thick, ae in the foreign *Cyrenœ;* emooth or concentrically striated and furrowed, and covered with an epiderinis. The hinge is furnished with cardinal and lateral teeth, and the ligament is external. The animale have plain-edged mantles opcn in front, eiphonal tnbes produced, and either partially separated or completely united to their unfringed extremities, and a large linguiform foot. They live buricd in the mud of slow etreame, lakee, ponds, ditchee, and eprings. Our native species are all ovoviviparous. They hreed readily in confinement, and often exhibit considerable activity, ascending the sides of the vessel in which they are placed. (Forbes and Hanley.) This family contains two British genera, *Cyclas* and *Pisidium.*

Cyclas has the shell equivalve, thin, euborbicular, more or lcss inflated, elightly inequilateral, closed, smooth, or concentrically etriated; cardinal teeth, ono in the right and two in the left valve; lateral teeth devcloped; ligament external.

C. rivicola has the shell oval, glohose, etriated; umbones ohtuse; dorsal area with a emall lunular impression; ligameut manifest.

The ordinery length of the finer epecimene is 10½ lines, and its hreadth about two-thirds of an inch.

The tnbee of the animal are tinged with rose or tawny, and when fully protruded are nearly equal, the branchial, if either, being longest.

The foot is large, white, and linguiform; the mantle white; the labial palpe long, triangular, and strongly striated. It is sluggish in its hahits.

Forbee and Hanley give the following localities:—The most prolific is the river Thames; it is found likewise in the New River (Baily); tho Trent (Jcnyns); the Lea (S. H.); the canals about Leamington, in Warwickshire (Thompson); etreams in Yorkshire (Bean). In a pond at Enville, Staffordshire, a young specimen (Jeffreys). It has uot been takeu either in Scotland or Ireland. Ou the Continent it occurs in Germany, France, and Belgium; and as a fossil is found in the Pleistocene Fresh-Water Beds of the eouth of England.

C. cornea, Linn. Shell euborbicular, almoet emooth; umbonee obtuse; ligament inconspicuous. There is a snbglobose variety (apparently the *Stagnicola* of Mr. Sheppard), which is flettened towarde the ventral margin, and has the pellucid aud ewollen umbonee peculiarly prominent. The dimensions of the larger typical form are six linee and a quarter in length, and five linee in hreadth; of the variety five lines and a half in length, and four and three-quarters in breadth.

The animal is white, its suh-elongated siphonal tubes tinted with pale flesh-colour. Mr. Jenyne ohservee that the superior tube is subconic, with a small aperture, the inferior cylindric and truncate, with a wider aperture.

This very common epecies ie a general inhabitant of rivers, ponds, and ditches throughout the country. It appears to thrive equally well both in running and in stagnant water. (Jenyns.)

It is also generally dietributed throughout Europe, and occurs fossil in fresh-water strata of the Pleiocene age in the valley of the Thames.

C. caliculata has the ehell more or less rhombic; umboncs narrow, more or leee prominent, capped.

Thie species ie apparently less infreqnent in the north than in the more southern parts of England. Mr. Alder has found it near Newcastle; Mr. Bean at Scarborough (where it is not scarce); Mr. Thompson at Lichfield; and Captain Brown records the vicinity of Manchester and the lakes of Westmoreland for its localitiee. Montagu met with it in Devonshire and Wiltshire; Mr. Jenyns at Bookham Common in Surrey, and more sparingly in Cambridgeshire; and Mr. H. Strickland at Hornsea in Yorkshire. Mr. Jeffreys has taken it in the Clumber Lake, Nottinghamshire, and in the neighbourhood of Bristol. In Ireland it is also rare. "On the Continent it occurs in Sweden, Germany, Belgium, France, and Italy. The *C. partumeia* of Say, in despite of the ventricoeity of the adult, is very closely allied, especially in outliue, to this species, and may be regarded as its transatlantic representative." (Forbes and Hanley.)

Pisidium has the ehell equivalve, thin, usually tumid, sub-oval, inequilateral, smooth or concentrically striated; hinge with one tooth in the right and usually two in the left valve; also lateral teeth; ligament external, inserted at the ehorter side.

The epeciee are very small bivalves, living iu similar localitiee with *Cyclas*, and not uucommon even in draine through meadows.

P. pusillum. Shell rouuded, oval, not greatly inequilateral, uot distinctly striated; valvee not ewollen, always a little compressed below; umbones usually broad, and but little projecting. This is by far the commoneet of the smaller *Pisidia* in thie country. It is found abundantly iu pouds and ditches. It inhabite generally northern and central Europe.

P. pulchellum. Shell small, striated (not grooved); umhones simple and without appendages. There are many varietiee of this shell. It has a great tendency to assume a multiplicity of forms. The average eize is a line and a helf long, and a line and a quarter broad. It is very common in many parts of Great Britain.

The other Britieh species of this geuue are—*P. Henslowianum, P. nitidum, P. cinereum* and *P. obtusale.*

CYCLA'MEN, a geuus of Plauts bolonging to the natural order *Primulaceœ*. It has a hell-shaped helf 5-cleft calyx; the corolla with a short bell-shaped tube, and 5-partite reflexed limb; 5 stamens ineerted at the bottom, on the tnbe of the corolla, iucluded; the capeule many-seeded, opening with 5 teeth. Tho spocies are herbaceous humble plants with very handeome flowers.

C. hederifolium has cordate angular crenate leaves, and the throat of the corolla with 5 teeth. The root consiets of a large depreseed tuber; the flowers are nearly white, seated upon long flower-stalke, which roll up after blossoming, and bury the germen. Thie plant has been fouud in Great Britain, at Sandhurst, aud near Cranbrook in Keut. It ie rare, and difficult of cultivation. Its flowers exhale a pleasant fragrauce.

C. Europœum, Common Cyclamen, has the leaves orbicular, cordate, crenate, or toothed, the segments of the corolla lanceolate. Thie species is found in the eouth of Europe. It has been recorded as a native of Great Britain, but, if fouud, has probably been an escape from gardens. It ie often confounded with the former speciee. This plant is abundant in Sicily, where the wild boars prefer it to auy other kind of food. Hence it is called Sow-Bread. It has been used medicinally; it acts upon the syetem as a cathartic, and was formerly esteemod emmenagogue. The acrid principle of the root has been separated under the name of Arthanatiue.

Several other epecies have heen described. Most of them are hardy plants, and may be grown on an open border. They are peculiarly adapted for pots aud for chamber decoration in spring. Ouo of the peculiaritiee of the genue ie, that the flowers are seated on a twisted pedicel, which, when the flowers fade, turn round eud round till they bury the capsule which they bear in the earth. In this position the seeds ripen and germinate, and produce other plants.

(Loudon, *Encyclopœdia of Plants;* Babington, *Manual of Botany;* Burnett, *Outlines of Botany;* Koch, *Flora Germanica.*)

CYCLANTHACEÆ, a group of Plants belonging to the class of Endogens, separated by some writere from the *Pandanaceœ*. It embraces the genera *Carludovica, Nipa, Cyclanthus*, and *Weltinia*. For an account of the order soe PANDANACEÆ.

CYCLA'RTHRUS, a genus of Fossil Fishes, from the Lias of Lymo Regis. (Agassiz.)

CYCLAS. [VENERIDÆ.]

CY'CLICA, a family of Coleopteroue Iusects. According to Latreille, this group forms a sub-section of the section *Tetramera.*

The family *Cyclica* contains the Linnæan genera *Hispa, Cassida*, and *Chrysomela*, the epeciee of which may be distiuguished by the following charactere:—Tarsi 4-jointed, furnished beneath with a velvet-like substance; the penultimate joint bilohed; autennæ of moderate length, generally filiform, or increasing in thickness towards the apex; body usually of a rounded or oval form, the thorax being at the base of the same width as the elytra.

These insects are ueually of brilliaut metallic colouring: various shades of green appear to predominate. Their larvæ have a eoft body, and are furniehed with six legs, attached two to eech of the first three eegments, or those next the head. They feed upon the leaves of plants.

To this group belong the following families:—*Cassidiadœ, Chrysomelidœ*, and *Galerucidœ*. The principal genera belouging to the family *Cassidiadœ* are *Alurnus, Hispa, Chalepus*, and *Cassida*. To these genera we shall at present confine our remarke.

The genus *Cassida* has the following characters:—Body oval or rounded, depressed; thorax generally eomewhat eemicircular, with the anterior portion produced so as to conceal the head; mandiblee with three notchee on the inuer edge; external lobe of the maxilla as long as the inner one.

The *Cassidæ* are usually of a somewhat flattened form, and are remarkable for their having the external margins of the elytra projecting beyond the body; the outer margins of the thorax are also produced, and conceal the head. Those parts which extend beyond the animal itself are generally semitransparent and flattened, whilst the parts which immediately cover the insect are more or less convex. When the insect is at rest, the legs, which are rather short and compressed, are retracted, and the external margins of the elytra and thorax are applied closely to the plant on which it lives. The larvæ of the *Cassidæ* are of a depressed form, and usually armed on the upper parts with numerous little spines; these are longest on the sides of the body and at the tail. The use of these little spines appears to be for the purpose of holding the excrement of the animal, which is always deposited upon its back, and probably serves as a means of defence, by concealing it from its enemies.

C. viridis, an insect not uncommon in this country, is about a quarter of an inch in length, and of a bright green colour above; the body beneath is black. This species lives both in the larva and imago states upon thistles.

Mr. Stephens, in his 'Catalogue of British Insects,' enumerates nineteen species of this genus.

The insects belonging to the other three genera of the *Cassidiadæ* have the body of a more elongated form than those just described, and the head is exposed, the margins of the thorax and elytra not being produced. They are all included in the genus *Hispa* of Linnæus.

CYCLOBRANCHIATA, an order in De Blainville's arrangement of the *Mollusca*. It includes those animals mostly referred to the Cuvierian order *Nudibranchiata*. [NUDIBRANCHIATA.]

CYCLOID FISHES. One great division of Fishes is thus termed by Agassiz, from the concentric striation apparent in their scales, of which the substance is horny, not bony nor enamelled. They are rare as fossils in all except the more recent strata, but abound at the present day. [FISHES.]

CYCLOLITES, a genus of *Madrephylliæa*, including single-celled species. [MADREPHYLLIÆA.]

CYCLOPOMA, a genus of Fossil Fishes, from Sheppey. (Agassiz.)

CYCLOPS. [BRANCHIOPODA.]

CYCLOPTERIS, a genus of Fossil Ferns (Brongniart), remarkable for the size and orbicular or oval shape of the leafits. To the species from the Coal-Measures (*C. orbicularis*, *C. obliqua*, &c.) this remark applies better than to those (*C. Beanii*, *C. dilatata*, &c.) from the Oolites, which are really of a different genus. [COAL-PLANTS.]

CYCLOPTERUS. [DISCOBOLI.]

CYCLOSIS. The regular movements of the contents observed in the interior of the cells of many plants have obtained this name, to distinguish them from other movements to which the vegetable cell is subject.

The fluid contents of the cells exhibit two kinds of movement, one in which there is observable in each cell a single current ascending on the one side and descending on the other, and another in which minute currents, with numerous anastomosing branches present themselves. The fluids which move vary in colour, transparency, and consistency, and carry with them whatever grains or globules of starch, protein, oil, chlorophyle, or other matters that may be loose in the interior of the cell.

The existence of these curious currents was first made known by Bonaventura Corti in 1772, who observed them in the sap of certain species of *Characeæ* and in *Caulinia fragilis*. Fontana about the same time confirmed these discoveries. They however excited no attention, and the facts seem to have been rediscovered by Treviranus in Germany in 1807, and Amici in Italy in 1819, and still later by Varley in England.

The number of plants in which these movements are observed is very numerous, and every day is adding to their number. It is not under all circumstances that the currents are developed. They are less active, and sometimes not at all seen, when the cell is very young or very old. When young the currents are not established, when old they cease. In some instances preparation of the plant is necessary. In some of the forms of *Chara* the bark external to the cells must be removed. In *Vallisneria spiralis* it is seen best when the leaf is cut in two. Heat also increases these movements, so that plants which fail at first to exhibit them, will do so after remaining a little time in a warm room. The persistence of this motion is very curious in some of the plants which exhibit it. Thus in *Vallisneria* it will continue in the leaf several months after it has been separated from its parent plant, and although the leaf exhibits the yellowness of decay. ('Microscopical Journal,' p. 55, vol. ii.)

Mr. Lawson of Edinburgh gives the following list of plants in which he has observed this movement of the cell-contents:—

Charæ and *Nitellæ*.
Sagittaria sagittifolia.
Stratiotes aloides.
Vallisneria spiralis.
Zannichellia palustris.
Hydrocharis morsus-ranæ.
Potamogeton.
Equisetum.
Anacharis Alsinastrum.
Loasæ (in stinging hairs).
Urticæ (in stinging hairs).
Tradescantia virginica (in hairs of filaments).
Campanula medium (hairs of corolla).
Marchantia (*polymorpha*?) (radical hairs).
Mosses.
Ceratophyllum.
Podostemaceæ.
Lemna.
Lichens.
Algæ.
Fungi.

These movements are best seen in the plants in which they were first discovered—in *Nitella*, *Hydrocharis*, and *Vallisneria*. Each of these has its peculiarities, and may be taken as examples of the rest. In *Nitella* the moving stream is very considerable, so that only a narrow streak remains at comparative rest between the ascending and descending currents. The stream is strong and rapid, and carries along with it starch granules of considerable size. Its course is not exactly parallel to the axis of the stem, but forms a small angle with it. In two contiguous cells, the currents flowing on the partition between them run in opposite directions; consequently, throughout the whole plant, the ascending streams are on one side, and in fact owing to their oblique direction form a spiral: this is the case also with the descending streams. If the cell be carefully tied across, the current is in a short time re-established in each sub-division. If the cell be cut through, the fluid escapes only on one side, the remainder of the fluid making the entire circuit of the cell before it comes to its turn to escape.

Mr. Lawson gives the following account of the movement in the new Water-Weed which has just appeared in this country, and is called by Mr. Babington *Anacharis Alsinastrum*. [UDORA; HYDROCHARIDACEÆ.] "The leaf of the *Anacharis* is composed of cells of an oblong form, but in some parts of the leaf becoming much elongated. At the margin of the leaf (which is toothed, each tooth consisting of a single somewhat triangular cell) the tissue consists of a single layer of cells, the latter being more elongated in form than those towards the centre of the leaf. In these marginal cells, the green granules (chlorophyle) which they contain may be readily seen in rotation, thus indicating the currents of cell-sap. The phenomenon is best seen however in those cells (very much elongated) which form the midrib of the leaf. Granules are seen scattered about in the cells; a few in the centre of each cell are fixed. But there will be observed another set of spherules, forming a continuous line around the margin of each cell; these are in rapid motion, flowing along one side of the cell, generally with great regularity, till they arrive at the end, where they cross over and return by the other side, thus forming a continuous rotation in the cell. Although the granules generally move on in this way without interruption closely following each other, still a casual interruption occasionally takes place, and crowding ensues; this is most frequent at the ends of the cells—at the 'crossing.' But the granules are gifted with even a greater share of politeness than is usually to be found at a London crossing; for when a crowding takes place, there is never seen an obstreperous granule trying to gain the precedence of his fellows to get over first."

The movements of the minute anastomosing currents are more difficult to observe than those above described. They do not occur alone in water-plants, but have been principally observed in the *Phanerogamia*. In the anastomosing currents the movement is always observed to and from the cytoblast of the cell, which is invariably present. The fluid is of a mucous (proteinaceous) nature, and mixed with minute opaque granules. The currents cover the internal surface of the cell-wall, or traverse the cavity of the cells from one wall to the other, without mingling with the rest of the cell-fluid, which for the most part is as clear as water. On this subject Schleiden says, "Up to the present time (1849) I have found this peculiar form of circulation in numerous cryptogamous plants, for instance, in *Achlya prolifera*, *Spriogyra*, and other *Hyphomycetes* and *Confervæ*; in almost all the forms of hair in the *Phanerogamia* that I have as yet examined, for instance, in the *Solanum tuberosum*; in many spores, such as of *Equisetum arvense*, and pollen granules, for instance of *Ænothera grandiflora* in the immature state; in almost all immature endosperm-cells, as in *Nuphar luteum*, and especially in such as are subsequently re-absorbed, as in *Ceratophyllum demersum*; in almost all stigma-papillæ, as in *Tulipa Gesneriana*; in the loose cells of juicy fruits in the young state, as in *Prunus domestica*; in the pulp which is formed by the placental cords, as in *Mammillaria*; less frequently in the loose juicy parenchyma of many plants in the young state, as in *Tradescantia rosea*. I believe it exists however in all vegetable-cells as long as the cytoblast retains its vitality. As instances admitting of verification, I would mention the fruit of *Symphoricarpos racemosus* (Snowberry) or of a *Mammillaria*."

In these instances each cell is isolated and filled with an entirely colourless fluid. At one part of the wall can be seen the cytoblast presenting a well-marked nucleolar corpuscle. The cytoblast is always surrounded by a narrow areola of a yellowish mucous fluid, thickly crowded with minute opaque granules, and from it proceed currents of various width and depth. The currents can be seen passing to or from the cytoblast. In their conrse they exhibit various anastomosing branches. Many of the streams are so minute that, under the highest magnifying power, they exhibit the appearance of a line without any breadth, merely rendered to a slight extent irregular by the individual granules.

The cause of these movements in the interior of the cells of plants has been the subject of much discussion. Although not observed in every instance, there appears to be reason for the inference that they are universally preseut, and that they are but the result of the living processes going on in the cell, and perhaps the mode by which nutrition is effected. "After the most careful research," says Schleiden, "with the best instruments, I have been unable to perceive a trace of the presence of vibratile cilia as a cause of the motion." And indeed if cilia had been discovered, the inquiry would then assume the form of the cause of movement in cilia. If this question be answered we get at an ultimate fact applicable alike to movements in granules, cilia, cytoblasts, or cells. One fact presents itself in all these cases, which seems worthy of every consideration, and that is the presence of some form of proteinaceous matter. In the fluid which circulates in the vegetable cell some form of protein is always present. The cytoblast or nucleus, and the primordial utricle in all cells are composed of protein. Cilia take their origin in all cases in a proteinaceous basis, and their movements appear to be but the result of an irritability, which in every case finds its origin in a proteinaceous compound. [Cells; Histology; Tissues, Vegetable.]

(Schleiden, *Principles of Scientific Botany*, translated by Lankester; *Microscopical Journal*, vols. i. and ii.; Huxley, *On the Identity of Structure of Plants and Animals*, Proc. Roy. Inst., 1853; Varley, *Transactions of Microscopical Society*.)

CYCLOSTOMA. [Helicidæ.]

CYDIPPE. [Acalephæ; Beroe.]

CYDO'NIA, a genus of Plants belonging to the natural order *Pomaceæ*.

C. vulgaris, Quince, a small tree with dark smooth branches. Leaves ovate, obtuse at the base, quite entire, cottony on the under side. Flowers large, solitary, with a cottony calyx and bright pink petals. The fruit a turbinate or roundish angular pome, covered with a thin cottony down, extremely austere, but having a peculiar fragrance.

There are two varieties—Apple-Quince and Pear-Quince. The seeds are the parts used in medicine, on account of the mucilage which they yield. The seeds are more numerous in the small hard than in the large fleshy fruits. They generally occur in large irregularly-shaped masses, as they easily adhere to each other, owing to the mucus which invests them. When moistened in the mouth or in water, they give out a large quantity of mucilage, which is white, and not coagulable by boracic acid. One part of these seeds will render 40 to 50 parts of water so mucilaginous that it will possess the thickness of a syrup. They should be set to digest in cold water, otherwise the mucilage acquires the odour of hydrocyanic acid. Indeed the actual presence of, or tendency to form, hydrocyanic acid, may be demonstrated by distillation. (Stockmann.) Many seeds yield a yellow-coloured mucilage. If allowed to remain in a fluid state the solution soon spoils, but by careful evaporation the mucilage may be brought to a dry state; or, as proposed by Zier, the mucilage may be precipitated from its watery solution by alcohol. Ten ounces of seeds yield two ounces of dried mucilage, two grains of which, with distilled water, produce one ounce of mucilage of proper consistence for use. In whatever way obtained, the mucilage possesses demulcent qualities, and may be employed either internally or as a lotion, which is especially applicable to the faces of those who suffer from the cold winds of winter and spring.

CYGNINÆ, a sub-family of Web-Footed Birds, belonging to the family *Anatidæ*, order *Anseres* of Linnæus, including the Swans.

Mr. Swainson makes the genus *Cygnus* the first of his sub-family *Anserinæ*, with the following character:—Size large. Base of the bill tumid, fleshy, and naked. Neck remarkably long. Feet short. Hinder toe simple. ('Classification of Birds.')

The Prince of Canino, in his 'Birds of Europe and North America,' arranges the *Anseres* as his fifth order of birds. The *Anatidæ* stand as the first order of the *Anseres*, and comprise the sub-families *Cygninæ*, *Anserinæ*, *Anatinæ*, *Fuligulinæ*, and *Merginæ*. The *Cygninæ* consist of the single genus *Cygnus*, of which the Prince records *C. Olor*, *C. immutabilis*, *C. musicus*, and *C. Bewickii* as European species, and *C. Americanus* and *C. Buccinator* as American species. The *Cygninæ* in the Prince's method are immediately followed by the *Anserinæ*.

Only two true Swans are recorded by Linnæus, and those as varieties of *Anas Cygnus*, namely, variety α, *C. ferus*, and variety β, *C. mansuetus*. Since his time the researches of zoologists have added considerably to the catalogue.

The peculiarities of organisation in this sub-family deserving of notice are—the great length of the neck, consisting of 23 vertebræ, and the cavity in the sternum for the reception of a considerable portion of the trachea.

The generic character of *Cygnus* is as follows:—Beak of equal breadth throughout its length; higher than wide at the base; depressed at the point; both mandibles furnished along the sides with transverse serrated lamellæ. Nostrils oblong, lateral, near the middle of the beak. Neck slender and very long. Legs short, the hind toe small and free. (Yarrell.)

C. ferus (Ray). Male.—Pure white, with occasionally a buff tinge on the top of the head. Bill black, and depressed anteriorly, quadrangular at the base, and yellow, which tint extends forward along each lateral margin of the upper mandible beyond the aperture of the nostrils, which are black; bare space between the base of that mandible and the eye also yellow, which colours the back part of the lower mandible. Iris brown. Feet black. Length, with neck stretched, about 5 feet; across expanded wings, about 8 feet. Female.—Similar to the male, but smaller, and the neck more slender. Young.—Those that we have seen, when about a week old, have been covered with a gray down above and a whitish down below, with flesh-coloured feet, or rather of a dusky flesh-colour; the bill flesh-coloured, and rather dusky above anteriorly. Mr. Yarrell states that at ten weeks old the bill is dull flesh-colour, the tip and lateral margins black; the head, neck, and all the upper surface of the body, pale ash-brown; the under surface before the legs of a paler brown; the portion behind the legs dull white; the legs, like the bill, of a dusky flesh-colour. This description was taken from young birds in the Garden of the Zoological Society, London, in the middle of August. In the middle of October the same zoologist found the bill black at the end, with a reddish-orange band across the nostrils, and the base and lore pale greenish-white; the general colour pale grayish-brown; a few of the smaller wing-coverts white, mixed with others of a pale buffy-brown, and the legs black. He also observes that the young Hoopers bred in 1839 had almost all their brown feathers at the autumnal moult of 1840, and that before their second winter was passed they were entirely white. ('British Birds.')

This is the *C. musicus* of Bechstein, and, as there are now more than one wild species well defined, the Prince of Canino and others adopt that specific name instead of the original *C. ferus*; but the propriety of this may be doubted. It is the Cygne Sauvage of the French; Cigno and Cigno Salvatico of the Italians; Singschwan and Nordöstliche Singschwan of the Germans; Vild Svane of the Danes; Hooper, Elk, and Whistling Swan, of the British; and Alarch Gwylt of the Welsh.

Head of Hooper (*Cygnus ferus*).

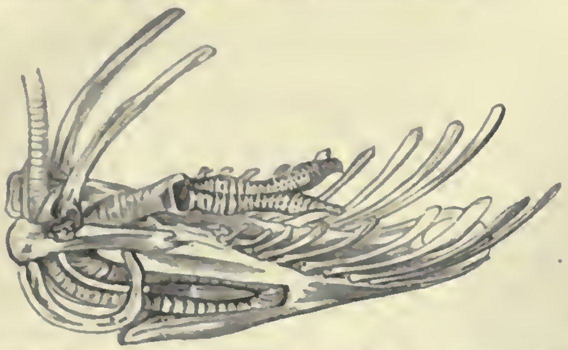
This bird is found in the northern regions of Europe and Asia, residing in summer within the arctic circle, Iceland, and Scandinavia. Winter visiter to the British Islands (where however it has been known to breed in the Shetland and Orkney Islands and in Sutherlandshire), Holland, France, Provence, and Italy, and, according to Mr. Bennett, going as far south as Barbary and Egypt. Eastward it extends as far as Japan. This species is in all probability the Swan so celebrated by the ancient poets for its dying song.

The note of this Wild Swan resembles the word 'hoop' uttered several times successively. They fly in a wedge-like figure, uttering this note as they proceed, and when heard from above it is not unmusical. The apparatus for producing these sounds was known to Aldrovandi, Sir Thomas Browne, Willughby, Ray, Latham, and others. Mr. Yarrell, who has paid so much attention to the tracheæ of birds, has thus well described it:—

"The cylindrical tube of the trachea or windpipe passes down the whole length of the long neck of the bird in the usual manner, but descends between the two branches of the forked bone called the merry-thought, to a level with the keel of the breast-bone or sternum. The keel of the breast-bone is double, and receives between its two plates or sides the tube of the trachea, which, after traversing nearly the whole length of the keel, turns suddenly upon itself, passing forwards, upwards, and again backwards till it ends in the vertical bone of divarication from whence the two long branchial tubes go off, one to each lobe of the lungs. The depth of the insertion is not so considerable in females or young males."

The Hooper, like the rest of the Swans, feeds on aquatic plants and insects, can keep the head under water for some time, but never dives. The large nest is constructed on the ground with flags, rushes, leaves, and marshy plants. The eggs, six or seven in number, are whitish, tinged with yellowish-green. Length of egg, 4 inches; breadth, 2¾ inches.

This species breeds in captivity, and may frequently be seen on ornamental pieces of water in a half-domesticated state.



Sternum of Hooper with a portion of one side of the keel removed to show the convoluted tube within. Yarrell.

C. Bewickii. Independent of external characters, the anatomical distinctions pointed out by Mr. Yarrell, who first proposed to separate the species under the name here given, clearly point out the difference between it and the Hooper. "The principal and most obvious difference," says Mr. Yarrell, "is in the trachea. The tube of the windpipe is of equal diameter throughout, and, descending in front of the neck, enters the keel of the sternum, which is hollow, as in the Hooper, traversing the whole length. Having arrived at the end of the keel, the tube, then gradually inclining upwards and outwards, passes into a cavity in the sternum destined to receive it, caused by a separation of the parallel horizontal plates of bone forming the posterior flattened portion of the breast-bone, and producing a convex protuberance on the inner surface. The tube also changing its direction from vertical to horizontal, and reaching within half an inch of the posterior edge, is reflected back after making a considerable curve, till it once more reaches the keel, again traversing which, in a line immediately over the first portion of the tube, it passes out under the arch of the merrythought, where, turning upwards, and afterwards backwards, it enters the body of the bird, to be attached to the lungs in the usual manner. This is the state of development in the oldest bird I have yet met with. The degree next in order, or younger, differs in having the horizontal loop of the trachea confined to one side only of the cavity in the sternum, both sides of which cavity are at this time formed, but the loop of the tube is not yet sufficiently elongated to occupy the whole space; and the third in order, from a still younger bird, possesses only the vertical insertion of the fold of the trachea." Mr. Yarrell adds however, that in this last case the cavity in the posterior part of the sternum already exists to a considerable extent.

Bewick's Swan is much smaller than the Hooper, the whole length being from 3 feet 10 inches to 4 feet 2 inches.

Head of Bewick's Swan (*Cygnus Bewickii*).

"Young birds," says Mr. Yarrell, "as they appear here in the plumage of their first winter, are grayish-brown. At their second winter, when they have acquired the white plumage, the irides are orange; the head and breast strongly marked with rusty red; base of the beak lemon-yellow; when older, some continue to exhibit a tinge of rust-colour on the head after that on the breast has passed off. The adult bird is of a pure unsullied white; the base of the beak orange-yellow; the irides dark; the legs, toes, and membranes black."

The anterior part of the bill is black, and, in the males, orange-yellow at the base, which is of a lemon-colour in the females.

It is found in the north of Europe and America certainly, and of Asia probably. It breeds within the arctic circle, and in Iceland in May, according to Temminck, who says that it has been found on the maritime coasts of Picardy. It is an occasional visiter to the British Islands, especially in severe winters.

The nest, according to Captain Lyon, is constructed of moss-peat, is nearly 6 feet long, 4¾ feet wide, and 2 feet high on the outside, with the cavity a foot and a half in diameter. The eggs, six or seven in number, are of a yellowish-brown, according to Temminck; brownish-white slightly clouded with a darker tint, according to Lyon. The call-note of this species is said to be a low-toned whistle, according to Mr. Sinclaire, but this was in confinement. Mr. Blackwall describes their calls in their wild flights as loud, and says that a flock of twenty-nine of them were very clamorous.

C. immutabilis (Yarrell), the Polish Swan, is another wild species, and its cygnets, unlike those of the other white swans, are pure white. It has been kept in captivity. Mr. Yarrell states that Lord Derby purchased a pair of these swans, and sent them to Knowsley. The female died. The male paired with a Mute Swan (*C. Olor*), and a brood was the result; but the hybrids, though old enough, neither paired among themselves nor with any of the Mute Swans on the same water.

Head of Polish Swan (*Cygnus immutabilis*).

The following is Mr. Yarrell's description of the Polish Swan:—

"In the adult bird the beak is reddish-orange; the nail, lateral margins, nostrils, and base of the upper mandible, black; the tubercle, even in an old male, of small size; the irides brown; the head, neck, and the whole of the plumage, pure white; legs, toes, and intervening membranes, slate-gray. From the point of the beak to the end of the tail, 57 inches. From the carpal joint to the end of the second quill-feather, which is the longest in the wing, 21½ inches; tarsus 4 inches; middle toe and nail, 5¾ inches. Its food and habits closely resemble those of the mute swan. The organ of voice appears, from one that I examined, to be like that of the mute swan; but Mr. Pelerin has found considerable differences in various parts of the head: the description and measurements were given in a paper published in the 'Magazine of Natural History' for 1839, p. 178."

Mr. Yarrell then extracts Mr. Pelerin's comparative measurements of the crania of adult Mute and Polish Swans, and states that he has verified all his observations.

C. Olor (Genus *Olor*, Wagl.). Our Mute half-domesticated Swan is too well known to require description. The trachea has none of the complicated structure of that of the Hooper, and is even more simple than that of the Black Swan. The large tubercle, or berry, as the swanherds term it, at the base of the bill, at once distinguishes this graceful species from its congeners.

Head of Mute Swan (*Cygnus Olor*).

It is the Cygne of the French; Cigno and Cigno Reale of the Italians; Schwan and Höcker Schwan of the Germans; Tam Svane of the Danes; Tame Swan or Mute Swan of the English; and Alarch of the Welch.

This elegant bird is said to exist in a wild state in Russia and Siberia. The Prince of Canino, in his 'Specchio Comparativo,' speaks of it as occurring in the neighbourhood of Rome ("raro avventizio d'inverno"); and, in his 'Birds of Europe and North America,' he gives north-eastern Europe as the locality. The Polish

Swan above noticed should not be forgotten in assigning these northern localities to our Tame Swan, and very probably was not by the skilful ornithologists who have noted these localities. Temminck says, "Habite en état sauvage les grandes mers de l'intérieur, surtout vers les contrées orientales de l'Europe."

In the Thames, at present, the greatest number of swans belongs to the Queen, and the companies of vintners and dyers own the next largest proportion; but the birds are far less numerous than they used to be. The swan-marks are made upon the upper mandible with a knife or other sharp instrument. The swan-hopping or upping, that is, the catching and taking up the swans to mark the cygnets, and renew that on the old birds if obliterated, in the presence of the royal swanherd's man, is still continued by the companies above mentioned. Below is the royal swan-mark used in the three last reigns and the present, from the cut given by Mr. Yarrell, in whose interesting 'British Birds' much curious information on this subject, together with no less than sixteen swan-marks, will be found.

Royal Swan-mark. Yarrell.

Sir John Richardson ('Fauna Boreali-Americana') records only two American swans, *C. Buccinator* and *C. Bewickii*. The Prince of Canino, in his 'Specchio Comparativo,' gave one, *Anas Cygnus* (meaning, apparently, the Hooper). Nuttall notices three:—1st, the Wild or Whistling Swan, *C. ferus* of Ray; 2nd, the Trumpeter Swan, *C. Buccinator*; and 3rd, *C. Bewickii*. The Prince, in his 'Birds of Europe and America,' records two species, *C. Americanus*, Sharpl. (*C. musicus*, Bonap.), and *C. Buccinator*; but he does not record *C. Bewickii* as an American species. Nuttall declares that in the winter of 1810 he saw two individuals of *C. ferus* (*C. musicus*, Bechst. and Bonap.) in a state of domestication near St. Louis (Missouri), which were obtained, with several others at the same time, in consequence of the extreme cold. The Prince of Canino evidently considers his *C. musicus*, which he gives as a synonym of *C. Americanus*, a different species from *C. Bewickii*, which last stands opposite to *C. Americanus* in the European column.

C. Buccinator. According to Sir John Richardson, it is the most common swan in the Fur Countries, and to which the bulk of the swan-skins imported by the Hudson's Bay Company belong.

Colour white, the forehead alone tinged with reddish-orange; bill, cere, and legs, entirely black. Bill nearly resembling that of *C. ferus* in form, though longer and rather more depressed. Wings: third quill the longest. Tail consisting of 24 feathers. A specimen in the Zoological Museum has the crown and cheeks bright chestnut. Total length 70 inches. (Richardson.)

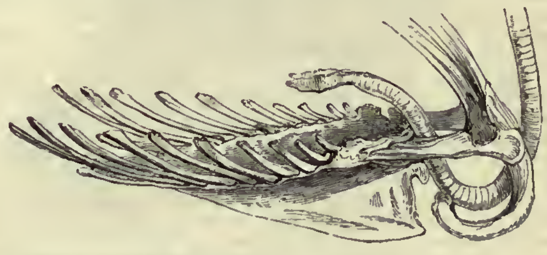
It breeds as far south as the 61st degree of latitude, but principally within the arctic circle, and in its migrations it generally precedes the geese. Sir John Richardson observes that *C. Bewickii* makes its appearance amongst the latest of the migratory birds; while *C. Buccinator* is the earliest, with the exception of the eagles. He states that a fold of its windpipe enters a protuberance on the dorsal or interior aspect of the sternum at its upper part, which is wanting both in *C. ferus* and *C. Bewickii*; in other respects, he adds, the windpipe is distributed through the sternum nearly as in the latter of these species. In the 'Supplement' to Sir Edward Parry's 'First Voyage,' *Anas Cygnus*, Wild Swan, with references which leave no doubt that the Hooper was meant, is noted as breeding on the North Georgian Islands; but *C. Bewickii* had not then been distinguished.

C. atratus (Genus *Chenopis*, Wagl.), the Black Swan. This bird, the *Anas Plutonia* of Shaw, has now become so common in our menageries, where it breeds freely, as not to justify the occupation of space with more than a cut of its head, and of the course of its trachea, which is not unlike that of the Mute Swan.

Head of Black Swan (*Cygnus atratus*).

It is all black, except the primary, and a few of the secondary quills, which are white. Bill bright red above, and sometimes with a slight turbercle at the base, which the female wants. The anterior part of the upper mandible is crossed by a whitish band, and the under one is grayish-white. Legs and feet dull ash-colour. Size less than that of the Mute Swan and Hooper. Irides red. Young, when about a fortnight old, covered with dusky-gray down above, lighter beneath; bill, eyes, and feet, dusky-black.

Mr. Yarrell observes that the structure of the trachea is intermediate between that of the Hooper and the common Mute Swan. "It quits the neck at the bottom, and descends to the centre circular portion of the furcula, to which bone it is firmly bound by a tough membrane: the remaining portion then rises over the front of the breast-bone between the clavicles, and passes backwards to the lungs, the last portion of the tube immediately preceding the bone of divarication being flattened horizontally. The form of the trachea in our common swan, in which it follows the neck without deviation, being remembered, and Dr. Latham's figure of the wild swan referred to, it will be observed that the black swan exhibits an interesting link between the two." ('Linn. Trans.' vol. xv.)



Sternum and trachea of Black Swan (*Cygnus atratus*). Yarrell.

It is found in Van Diemen's Land, New South Wales, and the west coast of Australia.

In a state of nature the Black Swans are generally seen floating on some lake in flocks of eight or nine. When disturbed, they generally fly off in line or single file; and are so shy, that it is difficult to get within gunshot. Their note is far from harsh, at least when uttered in captivity.

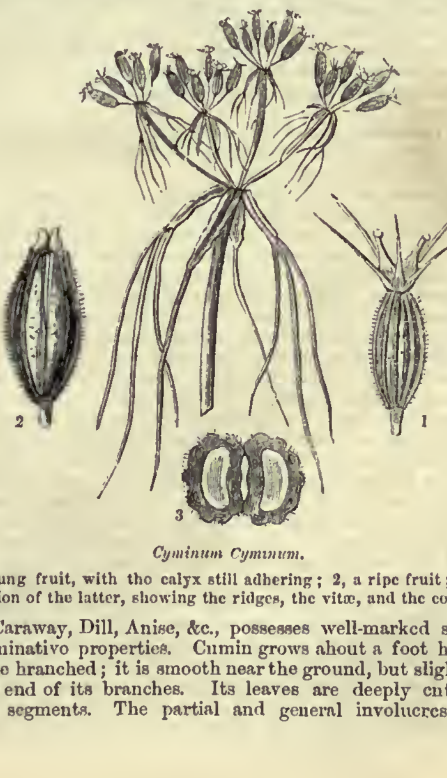
CYGNUS. [CYGNINÆ.]

CYMBA. [ACALEPHÆ.]

CYMBULA. [THECOSOMATA.]

CYME, an irregular kind of panicle, having a corymbose appearance, and in which each branch is stopped in its growth after producing a single flower, when it is forced to form lateral branches, which are themselves stopped after forming one flower. The common *Laurustinus* or the Elder-Bush offers examples of this sort of inflorescence.

CY'MINUM, or CUMINUM, a genus of Plants belonging to the natural order *Umbelliferæ*. *C. Cyminum*, Cumin, is a plant of annual duration, found wild in Egypt and Syria, and cultivated from time immemorial for the sake of its agreeable aromatic fruit, which, like



Cyminum Cyminum.

1, a young fruit, with the calyx still adhering; 2, a ripe fruit; 3, a transverse section of the latter, showing the ridges, the vittæ, and the commissure.

that of Caraway, Dill, Anise, &c., possesses well-marked stimulating and carminative properties. Cumin grows about a foot high, and is very little branched; it is smooth near the ground, but slightly downy near the end of its branches. Its leaves are deeply cut into long capillary segments. The partial and general involucres consist of similar leaves, but smaller. The flowers are white or reddish; the fruit is contracted at the side, surmounted by a calyx with long bristle-pointed divisions, and has each of its halves marked by nine unequal elevated ridges, all of which are slightly muricated, especially the secondary ones, under each of which there is a vitta. Two vittæ are present on the commissure, and the albumen is not involute.

Cumin is said to be employed in flavouring Dutch cheese. The fruits are carminative, but the smell is disagreeable. They are chiefly used in veterinary surgery. Combined with resin they make a warm stimulating plaster. [CUMIN, in ARTS AND SC. DIV.]

CYMODOCEA. [ISOPODA.]

CYMOPHANE. [CHRYSOBERYL.]

CYMOTHEA. [ISOPODA.]

CYNANCHUM (from κύων, a dog, and ἄγχω, to strangle), a genus of Plants belonging to the natural order *Asclepiadaceæ*. It has a 5-parted somewhat rotate corolla; a coronet of appendages consolidated, 5-20-lobed, when 5-lobed with the segments opposite the anthers; the pollen-masses ventricose, pendulous; the stigma usually apiculate, sometimes blunt, very rarely with a beak inclosed below the summit; the follicles smooth. The species are herbs or under-shrubs, with opposite leaves and mostly twining stems.

C. Vincetoxicum has an erect stem, a beardless corolla, a simple umbel with the pedicels three times longer then the peduncle; the corona 5-lobed. This plant is a native of sandy places in most parts of Europe, with the exception of Great Britain. It possesses emetic and purgative properties, and was once celebrated as an antidote for poisons, from which it has derived its specific name.

C. Monspeliacum, Montpellier Cynanchum, is an herbaceous twining glabrous plant, with roundish cordate-stalked leaves, with a semi-lanceolate contracted point; the segments of the corolla lanceolate, bluntish; the coronet tubular. It is a native of the sea-coast of Italy, of Spain, the south of France, and Greece. The juice of this plant is a drastic cathartic, and when dried it is used as a medicine under the name of Montpellier Scammony.

C. ovalifolium is a smooth twining plant, with oblong oval acuminate leaves; many-flowered cymes; peduncles not longer than the petiole; the coronet 10-cleft, about as long as the corolla; the stigma pointed, emarginate. This plant is a native of Penang, where, according to Dr. Wallich, it is used for the purpose of procuring from its sap caoutchouc, which is of an excellent quality.

C. Argel has erect, pale, round stems; the leaves scarcely stalked; about an inch long, ovate lanceolate, acute, smooth on each side, and rather wrinkled, glaucous on the under side; the corymbs small, axillary, with many smooth alternate branches; the sepals lancolate; the corolla white, but little longer than the calyx. It is a native of Upper Egypt. The leaves and the whole plant act as a powerful drastic purgative. This plant appears to be a native of the same districts as those from which the Alexandrian Senna is obtained, and all the samples of that senna contain these leaves. They do not however appear to be added for the purposes of adulteration, but are collected with the leaves of the senna through the ignorance of the persons employed in their collection. The leaves of Tinnivelly Senna are not found to contain those of the *C. Argel* mixed with them. Much of the unpleasant griping effect of the Alexandrian Senna is attributed by some writers on Materia Medica to the mixture of the leaves of the Argel. Senna leaves are also mixed with those of the *Gomphocarpus fruticosus*, which are in Syria also called Argel, or Arghel.

The *C. Ipecacuanha* of Willdenow, the *Asclepias asthmatica* of Roxburgh, is now referred to the genus *Tylophora*. [TYLOPHORA.]

CYNANTHUS. [TROCHILIDÆ.]

CY'NARA, a genus of Plants belonging to the natural order *Compositæ*, in many respects like the thistle, but having an involucre composed of thick fleshy spiny scales, and a remarkably thick fleshy receptacle, covered over with numerous bristles. The two species most known are the Artichoke and the Cardoon.

C. Scolymus, the Artichoke, so long cultivated in our gardens as a vegetable, came originally from the south of Europe, and though it has long been cultivated in the regions of the north, it does not resist the very severe cold of winter. Its perennial root is thick, fleshy, hard, branching, and gives rise to a cylindrical, glabrous, rather branching stem, from 2 to 3 feet high, to which are attached very large pinnatifid leaves, of a pale green above, whitish beneath, deeply serrated in lobes, and irregularly toothed. The heads stand singly at the top of the ramifications of the stem; they are as large as the doubled fist; their receptacle is very thick, fleshy, concave, furnished with simple bristles; the leaflets of the involucre are broad, thick, and terminated in a spiny point. All the florets are hermaphrodite, and of a clear violet colour; the tube of the corolla is very long; its limb has 5 very narrow segments; the staminal tube is very prominent, of the same colour as the corolla. The pappus is sessile and feathery. The root of the Artichoke is rather bitter, the stem still more so. It was formerly employed as a diuretic, but it has long been cultivated only as a kitchen-garden plant. Everybody knows that the heads of the plant are gathered before the expansion of the flowers, and that the receptacles or the base of the involucral scales are eaten either raw or after having been boiled in water. The Artichoke when cooked is an agreeable food, not very nourishing perhaps, but easy to digest. The receptacles, or artichoke bottoms, may be preserved for winter use by drying them after having blanched them in boiling water. The Arabians consider the root of the Artichoke an aperient; they call the gum of it Kunkirzud, and place it among their emetics.

C. carduncellus, the Cardoon. The country of the Cardoon is the same as that of the artichoke; it is found in the southern countries of Europe and in the north of Africa. Its thick and fleshy leaves cut into spiny lobes with very prominent ribs, its more slender stems terminated by heads of flowers three or four times smaller, with a thin receptacle, and the scales of the involucre armed with sharp spines, easily distinguish it from the artichoke. Some authors however have endeavoured to prove that the artichoke is only a variety of the Cardoon. This opinion however does not appear well founded; for if it were so among the great quantity of Cardoons that are cultivated in gardens, some plants would be found transformed into artichokes, which has never happened. In this species it is the rib, or the middle nerve of the leaves, which is eaten. When cooked it is tender, and its flavour greatly resembles that of the artichoke. It is in general a choice dish, and seldom seen except at the tables of persons in easy circumstances.

CYNARA'CEÆ, or CYNAROCEPHALÆ, one of the primary subdivisions, in the system of Jussieu, of the natural order *Compositæ*. It is included in the *Tubulifloræ* of De Candolle. It is characterised by an erect seed, the absence of albumen, a hemispherical involucre, the florets of the ray of the flower tubular, inflated, and regular. Of the three subdivisions of *Compositæ* this is the smallest. Its type is the genus *Cynara*, to which belongs the common Artichoke, *C. Scolymus*.

The genera of British plants belonging to this subdivision are as follows:—

Section I.—*Carlineæ*.		
	Saussurea	1 species.
	Carlina	1 species.
Section II.—*Centaureæ*.		
	Centaurea	7 species.
Section III.—*Carduineæ*.		
	Arctium	2 species.
	Onopordum	1 species.
	Carduus	12 species.
Section IV.—*Silybeæ*.		
	Silybum	1 species.
Section V.—*Serratuleæ*.		
	Serratula	1 species.

The *Cynaraceæ* differ from the *Corymbiferæ* in their active properties in possessing in a more intense degree the bitter principle of the whole order. None of them seem to possess a tendency to develop the narcotic principle which characterises the *Cichoraceæ*; nor is the volatile oil which gives to so many of the *Corymbiferæ* a peculiar aromatic smell developed in these plants. The *Carduus nutans* (Musk Thistle) is the only one which possesses any remarkable amount of odour. The prevalence of the bitter principle renders many of them useful stomachic, tonic, and febrifuge medicines. For these purposes *Centaurea*, *Calcitrapa*, *Cnicus benedictus*, *Carduus lanatus*, *Serratula arvensis*, and *Silybum Marianum* have been used. Some of them are said to be cathartic, and *Echinops sphærocephalus*, which has this property, is used in Languedoc as a remedy for rheumatism. The seeds of various species of *Onopordum* yield a fixed oil, which in some parts is expressed and used for domestic purposes. Many of the *Cynaraceæ* yield colouring-matters. The *Carthamus tinctorius* yields a yellow colour, and is employed to adulterate saffron; *Serratula tinctoria* yields a yellow dye of a fine colour. A pigment of a blue colour is obtained from the flowers of *Centaurea cyanus*. Some of them secrete small quantities of tannin, and are used in consequence as astringents in medicine, as the *Onopordum acanthium*. Galls also are found on the *Cnicus arvensis*, which possess astringent properties, owing to the tannin they contain. A number of species yield food. The bracts of the involucre are in some very large; and, as they contain starchy and other alimentary secretions, are used as diet by man. The Artichoke is a familiar instance. The heads of the *Onopordum acanthium* are often eaten in the same way. The tender sprouts of the *Arctium Lappa* are gathered and eaten in the north of Europe. They are cooked in the same manner as asparagus. The tubers of the *Cnicus tuberosus* are frequently cooked and eaten, and many other species yield starch in their roots. Animals do not generally like the plants belonging to the *Compositæ*. They seem however occasionally to eat them medicinally, and the ass prefers the thistle to most other kinds of food.

(Burnett, *Outlines of Botany*; Lindley, *Flora Medica*; Babington, *Manual of British Botany*.)

CYNA'RRHODON, a name given sometimes to the hep of the rose, which is a fruit composed of a succulent calyx-tube inclosing a number of hard dry hairy nuts.

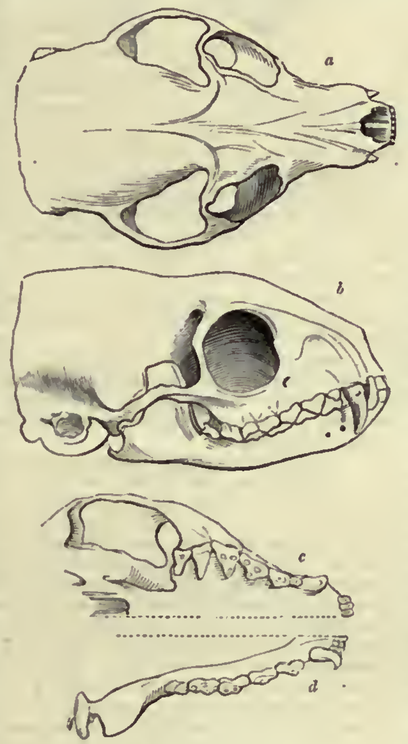
CYNICTIS, a genus of Animals belonging to the order *Carnivora*, established by Mr. Ogilby for an animal connecting the Family of the Civets with that of the Dogs.

It has the following generic characters:—

Dental formula:—Incisors, $\frac{6}{6}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{6-6}{5-5}=38$.

Of these last the first three are spurious, the fourth is the carnassier, and the rest are tuberculated. Feet, digitigrade; toes, 5-4, with long falcular claws adapted for digging. Tail long, bushy.

"This system of dentition," says Mr. Ogilby, "is, in most respects, extremely similar to that which is common to the *Viverræ* in general, and particularly to the genus *Herpestes*, from which the *Cynictis* differs principally in the absence of the rudimentary false molar of the lower jaw, in having that of the upper jaw in contact with the canine, and in a few other circumstances of very minor importance when compared with the general character of the organisation. From the *Ryzæna* or Suricate, on the other hand, the dental system of *Cynictis* differs in the presence of the superior rudimentary false molar, being thus directly intermediate in point of dentition between this genus and the *Herpestes;* and it is not a little singular that it should bear precisely the same relation to both these genera in the form and number of its toes. The *Herpestes* have rudimentary false molars both in the upper and under jaws, and five toes both before and behind; the *Cynictis* has rudimentary false molars only in the upper jaw, five toes on the fore and only four on the hind feet; the *Ryzæna* has no rudimentary false molars in either jaw, and four toes only, as well on the anterior as on the posterior extremities. These traits of zoological character strongly point out the true natural relations of all these animals, and demonstrate the relative positions which they occupy in the system of nature. With the single exception of the *Proteles*, there is no other known genus of the *Viverra* family which possesses the same number of toes and complete digitigrade extremities which form so prominent a character in the *Cynictis*. Here however all analogy ceases between these two genera. It is true that we are at present ignorant of the adult characters of the dentition of the *Proteles;* when we become better acquainted with this important part of its organisation we may perhaps discover additional points of relation between it and the present genus; but in all its most striking external characters it is completely different, and seems to occupy an intermediate station between the Dogs, the Civets, and the Hyænas. In addition to these characters the *Cynictis* may be readily distinguished by its external form and appearance from all conterminous genera. It has a short head, contracted suddenly in front of the eyes, and forming a small naked muzzle, divided by a longitudinal furrow; the ears are short and elliptical, naked inside, and directed forwards; the body long and slender; the tail bushy, and two-thirds of the length of the body, and the whole external form and appearance not unlike that of a Ferret or Ichneumon. The temporal fossæ are separated from the orbits by a complete rim of bone."



Skull of *Cynictis*.

a, seen from above; *b*, profile of the same; *c*, half of cranium seen from below, showing the position of the teeth in the upper jaw; *d*, half of the lower jaw seen from above (from Mr. Ogilby's figure).

C. Steedmannii (Ogilby), named after Mr. Steedman, to whom zoologists are indebted for a knowledge of the animal. It has the following synonyms in the 'British Museum Catalogue':—The Meerkat, *C. Levaillantii*, *Herpestes penicillatus*, Cuv.; *Ichneumon albescens*, J. Geoffroy; *C. pictus*, A. Smith; *Mangusta Levaillantii*, A. Smith; Meerkat, Barrow; Rattel, Swainson; *C. Ogilbyii*, A. Smith.

The length of the head from the muzzle to the root of the ear is 2¼ inches; length of the ear ¾ of an inch; breadth of the ear 1⅜ inch; length of the body from the muzzle to the root of tail 1 foot 6 inches; length of the tail 1 foot; height at the shoulder 7 inches; height at the croup 7¼ inches. Hair moderately fine in quality, much resembling that of a dog, smooth and close on the body, long and bushy on the tail. The general colour, as well as the whole external appearance, precisely that of a small Fox; bright red over the entire body, head, and extremities; deep and uniform on the back, but mixed with silvery gray on the cheeks, neck, sides, and tail, arising from a mixture of hairs tipt with gray, and dispersed through the fur of these parts. The breast, belly, and legs unmixed red; and the tail, which precisely resembles the brush of a fox, covered with long bushy hairs of a sandy-red colour at the roots, dark brown in the centre, and gray at the points; the last two inches at the tip of the tail uniform dirty white. Hair of the body not annulated as in *Herpestes* and the Suricate, and altogether of a finer and more furry quality. External form and appearance comparable with those of the Ferret and Egyptian Ichneumon, but probably standing higher on the legs as being more completely digitigrade.

Cynictis Steedmannii (Meerkat).

It is a native of Uyteuhage, on the borders of Kaffraria. (Ogilby.)

Mr. Ogilby thus concludes his observations on this interesting animal:—"In consulting the works of travellers through the colony of the Cape of Good Hope I have been able to find but two notices which seem clearly to refer to this animal; one by Dr. Sparrman, the other by Mr. Barrow. The first of these authors, in the English translation of his 'Travels,' vol. ii. p. 184, has the following passage: 'Two other small animals, which probably likewise belong to the *Viverra* genus, I had only a hasty glimpse of in this colony. The one we saw and gave chase to between the two Fish Rivers made its escape from us however by running into a hole underground, and seemed to be somewhat less than a cat, though longer in proportion. The colour of it was a bright red.' It is true that this passage records no observation by which we can with certainty refer the animal to which it alludes to the *C. Steedmannii*, but the size, colour, and habitat are so perfectly similar in both cases, as to render their identity extremely probable. In the following extract however from Barrow's 'Travels,' vol. i. p. 185, the characters are fully reported: 'Upon these parched plains [those of Camdebo, on the eastern confines of the colony] are also found several species of a small quadruped which burrows in the ground, and which is known to the colonists under the general name of Meerkat. They are mostly of the genus of animals to which zoologists have given the name of *Viverra*. An eagle making a stoop at one of these, close to where we were passing, missed his prey, and both fell a sacrifice, one to the gun, the other to the dogs. Both the bird and quadruped appeared to be undescribed species. . . . The *Viverra* was wholly of a bright chestnut colour; the tail shaded with black hairs, bushy, straight, and white at the extremity; ears, short and round; on the fore feet five and on the hind four toes; the body and tail each one foot long.' "There can be no doubt," continues Mr. Ogilby, "of the animal to which this description refers, a description more minute and accurate than we generally find in the works of travellers. It agrees in every point with the species which forms the subject of the present memoir, except perhaps in the reported dimensions of the tail and body; but this difference most probably arises from the age or sex of the specimens, or from the measures of Mr. Barrow being taken in a straight line, whilst mine followed the different curvature of the head, neck, and body. The name Meer-kat, by which it appears this animal is known to the colonists, signifies a monkey, and is of very general acceptation in South Africa, being applied indifferently to the present species, the Cape *Herpestes*, Ground Squirrels, and various other small burrowing animals. Both the passages here quoted confirm the burrowing habits of the *C. Steedmannii*, which I had already inferred from the form of the claws."

CYNIPS. [GALLS.]

CYNOCEPHALUS. [BABOON.]

CY'NODON, a genus of Grasses belonging to the tribe *Chlorideæ*. It has a 1-flowered fingered spike, with a superior rudiment; the glumes nearly equal, patent; the paleæ equal, outer boat-shaped, compressed, embracing the inner; the styles long, distinct; the stigmas feathery, protruding below the summit of the floret.

C. Dactylon has 3-5 digitate spikes; smooth paleæ, the leaves downy beneath; the scions prostrate. It is a native of England, on the shores of Devon and Cornwall. *C. linearis* is a native of the East, and is known by the name of Durva-Grass.

(Babington, *Manual of British Botany.*)

CYNOGLOSSUM (from κύων, a dog, and γλῶσσα, a tongue), a genus of Plants belonging to the natural order *Boragineæ*. It has a 5-cleft calyx; a funnel-shaped corolla with the mouth closed, with prominent blunt scales; the stamens included, filaments very short; the nuts roundish-ovate, depressed, muricated, attached by their inner edge. The species are herbs, with soft leaves.

C. officinale, Common Hound's Tongue, has the leaves downy, acute; the lower leaves elliptical, contracting into a petiole, the upper leaves lanceolate, narrowed below, subcordate, half-clasping. The corollas are of a dull red colour. It is a native of Asia, Africa, North America, and Europe. It is found in Great Britain in waste ground. The whole plant has a disagreeable smell, resembling that from mice. It is said to possess narcotic properties, and was at one time used as a remedy in scrofula, but it is not employed in medicine at the present day.

C. montanum has the leaves slightly hairy, acute, nearly glabrous and shining above, scabrous beneath, inferior, oblong, narrowed into a long petiole, upper leaves lanceolate, slightly narrowed below, clasping. It is found in Great Britain by road-sides and in hedges in shady situations.

About fifty other species of *Cynoglossum* have been described, besides the British ones above named. They are all coarse plants, having only small flowers, so that few only are desirable for ornamental cultivation. They are however of the most easy culture, and will grow in almost any situation and soil. The greater number of the species are biennial, and may be propagated by sowing their seed in spring in the open border.

(Babington, *Manual;* Don, *Dichlamydeous Plants.*)

CYNOMORIA'CEÆ, an obscure order of Rhizanths, distinguished from *Balanophoraceæ* by their distinct stamens, and the imperfect perianth of the male flowers. The order is represented by *Cynomorium coccineum*, the *Fungus Melitensis* of the old herbalists, a plant once in repute for its astringent properties, but now valued only for its rarity, and the botanical interest that attaches to it. Dr. Walsh tells us that "it grows most plentifully on a detached rock on the south-west side of the island of Gozo. It is there much celebrated for its medicinal properties: the time of the discovery of its virtues is not known, but from some ancient manuscripts it appears to have been at a very remote period. It had been the usage of Malta to banish to Gozo all females of dishonest character, and here, according to tradition, they found a vegetable substance of an astringent quality, which proved very efficacious in removing the consequences of their irregular life. It was prepared in earthen pots, some of which have since been dug up in various places, marked with Phœnician characters indicating their use. The plant was also applied by them to the purposes of divination. It was laid between the breasts, and from some accidental circumstances of position, &c., they augured good or bad fortune. This practice was reproved, and said to be finally abolished, by a Capuchin missionary. This curious vegetable was subsequently esteemed as a remedy in dysentery, and its curative powers were long held in very high repute. About the year 1740 the Knights of Malta set such a very high value on this fungus, that they interdicted the approach of any person to the place where it grew, and guarded the passage with the strictest jealousy. In April, when the fungus was ripe, it was carefully gathered by persons appointed for that especial duty, and the precious morsels were deposited in a government office, whence some portions were sent as presents by the grand-master to different sovereigns, and the remainder distributed among the hospitals of the island. Even after the English took possession of Malta, and succeeded to the territorial rights of the order, and, amongst other things, to the possession of this rock, a custode was appointed to take care of it as heretofore, with a salary, which always makes an item in the public accounts of Malta. The fungus is thus continued to be guarded and regularly gathered, deposited in the state-office, and distributed among the hospitals; and when Dr. Hamilton, through the kindness of an official person in Gozo, was permitted to visit this rock, he was accompanied by the custode. The rock, as shown by the doctor's sketch, is difficult of approach: it is an isolated precipice, about 600 feet in height, detached from the neighbouring shore, and presenting very steep and inaccessible sides, in some places projecting considerably over the sea, so that the circumference of the base is less than that of the upper parts. It stands on the verge of a noble circular basin, formed by the surrounding cliffs, into which the sea enters by the chasms at each side of the fungus rock, the whole presenting the aspect of the crater of a volcano, raised from beneath, or extinguished by the irruption of the sea."

CYNOPTERUS. [CHEIROPTERA.]

CYNOSURUS, a genus of Plants belonging to the natural order of Grasses.

C. cristatus, a well-known pasture-grass, called by farmers Crested Dogstail, or Gold-Seed, is exceedingly abundant in all natural and artificial grass-land. It grows with a slender smooth stem to the height of one or two feet, and is terminated by a somewhat cylindrical spike-like panicle of short clusters of flowers; each cluster consists of two flowered spikelets resting upon pinnate bracts. The glumes are 2, about the length of the florets; the paleæ 2, of which the lowest is sharp-pointed. The styles are feathery; the fruit is a small yellow smooth shining seed-like body, whence the common name of Gold-Seed.

Crested Dogstail (*Cynosurus cristatus*).

Although this grass forms so constantly a portion of all good pastures, it is chiefly on account of the fineness and closeness of its herbage that it is valuable, the quantity of hay that it produces being inconsiderable. Mr. Sinclair hence observes, that "it is inferior for the purposes of hay, but admirably adapted for permanent pastures. The roots penetrate a great way under ground, from which circumstance it remains green after most other grasses are burnt by a continuance of dry weather. In irrigated meadows it arrives at a greater size than in any other situation." Sheep are said to be less liable to be affected by the disease called the 'foot-rot' when fed on pastures containing a considerable portion of this grass than on such as are composed of the more tender and soft-leaved sorts.

C. echinotus is another species of this grass, found in Guernsey and Jersey. It has an erect stem, one or two feet high; the scales of the appendage with long points. It is extremely rare.

CY'NTHIA, a genus of Ascidian *Mollusca*. It consists of those Ascidians whose body is sessile, and which have the branchial sac plaited longitudinally, and the reticulation continuous; branchial and anal orifices opening in four rays or lobes. Their external envelope or test is coriaceous.

Messrs. Forbes and Hanley, in the 'History of British Mollusca,' enumerate 13 species of this genus as natives of the seas of the British Isles.

C. rustica has the body more or less globular or botryoidal, rugose, usually of a rusty red; apertures sessile, placed apart, deeply tinged with rose-red. From half an inch to two inches in length. It is common on most parts of our coast, and is found attached to various kinds of sea-weeds.

C. claudicans has a tuberous body; the test wrinkled and furrowed in every direction; the orifices are small, deeply 4-lobed, and placed on slightly prominent conical projections. It is about an inch in height, and is found attached to oysters.

C. aggregata has a bottle-shaped body with terminal approximate orifices. It was found gregarious in vast numbers by Professor E. Forbes and Mr. M'Andrew in twelve fathoms' water at Dartmouth. It was found under large stones; and on many of the branching root-fibres there were small, tough, globular, imperforated, orange-coloured bodies of various sizes full of granules. This form seems to be intermediate, and between the single and social Ascidians, and "should probably rank as the type of a distinct genus." (Forbes and Hanley.)

CYPER'ACEÆ, *Sedges*, an extensive natural order of Glumaceous Endogenous Plants, having much the appearance of Grasses, with which

Cyperus fuscus.

1, a spikelet magnified; 2, a flower with its bract; 3, a fruit; 4, a section of a seed.

they are sometimes popularly confounded. They differ in their stems being usually solid, not hollow, and angular, not round; in the sheaths of their leaves not opening on one side, but forming perfect tubes when the stem is pulled through them; in their male florets having no paleæ nor any covering to the stamens except a single bract, while the bisexual florets have nothing more than a few hypogynous bristles superadded; and finally, in their embryo being inclosed in the albumen, and not lying at one side of it. There are other distinctions besides these, but what have been mentioned are the most remarkable. A large proportion of the order bears the name of Sedges, and hence the Sedge Family or Tribe is given to these plants as their English appellation. They are mostly inhabitants of marshy or swampy grounds; a few are met with on dry upland pastures, and a good many are alpine plants. They occur in all parts of the world, and are generally abundant, but little or nothing has been discovered of their uses; their most common application is to the manufacture of what are called erroneously rush-mats and rush-bottoms for chairs. The plant used in this country for such purposes is not any kind of rush, but the cyperaceous species *Scirpus lacustris*. It is not a little remarkable that, nearly as these plants are allied to Grasses, they scarcely at all participate in the nutritious quality of that useful order; it is only among the coarse bad herbage of marshes that they are allowed to form a constituent of hay.

The following is a synopsis of the British genera of this order:—

Tribe I. *Cypereæ.* Flowers perfect. Glumes 2-ranked. Perigone absent.

- *Cyperus* . . . . . 2 species.
- *Schœnus nigricans.*

Tribe II. *Scirpeæ.* Flowers perfect. Glumes imbricated on all sides. Perigone absent.

- *Cladium mariscus.*
- *Rhyncospora* . . . 2 species.
- *Eleocharis* . . . . 4 species.
- *Scirpus* . . . . . 14 species.
- *Blysmus* . . . . 2 species.
- *Eriophorum* . . . . 6 species.

Tribe III. *Elyneæ.* Flowers diclinous. Perigone absent, or formed of one or two scales.

- *Kobresia caricina.*

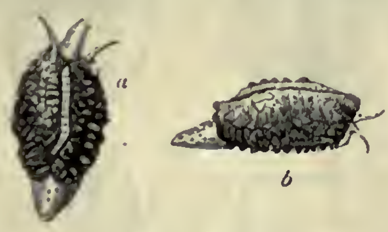
Tribe IV. Flowers diclinous. Nut completely inclosed in the urceolate perigone.

- *Carex* . . . . . 72 species.

(Babington, *Manual of British Botany*, 1851.)

CYPRÆ'IDÆ, the *Cowry Family*, Cowries, or sometimes Gowries—Porcellanen of the Germans; Porcelaines (Porcelain shells) of the French—a family of Marine Gasteropodous *Mollusca*, well known in commerce from one of the species (*C. Moneta*) being used in some parts of the East as a circulating medium.

This group of shells is characterised by the animal being unisexual, elongated; head distinct, with two conical or subulate tentacula of some length, at the external base of which are situated the two sessile eyes on small projections; mouth vertical, at the bottom of a small cavity, and containing a lingual riband, or lamina, beset with tentacles and prolonged in the abdomen. Branchial cavity open, situated near the back of the neck; gills arranged in a longitudinal pectinated series on the inside of the columella on the left side of the mantle; siphon very short, and formed in the mesial line by the edges of the two lobes. Mantle bilobated, the lobes very large with extended aliform edges, capable of being reflected over the back of the shell so as to join on the mesial dorsal line. Foot oval, elongated, very large. Vent at the extremity of a tube behind the branchial cavity. Male organ situated more forward, and communicating with the orifice of the deferent canal by means of a furrow. Adult shell involute, highly enamelled, oval or oblong, more or less rounded or cylindrical, with a small and imbedded spire; aperture longitudinal, nearly straight, toothed, or plaited, on each side, with a channel or groove at each end, inner lip flattened or sub-concave, outer lip involute. No operculum.



Cypræa (Trivia) Pediculus.
a, the animal seen from above; *b*, side view of the same.

Dr. J. E. Gray, whose arrangement we select as being in our opinion the best which has hitherto appeared, thus notices the very great change of form that the young shell undergoes in its progress to perfection:—"The shell alters its appearance considerably according to the age of the individual, and exhibits three very distinct stages. In the young or first stages the shell is generally smooth, of a plain grayish colour, or with three longitudinal bands, and the upper part of the inner lip is smooth, convex, the lower part flat or concave; the outer lip thin. In the second stage the shell begins to assume more the character of the genus, as the outer lip begins to be inflected or rather thickened, and approaches nearer the perfect appearance of the species as the second coat of colour is deposited; but

Cypræa Exanthema, illustrating the stages of growth.
a, young shell in the first stage, seen from above, view of the back; *b*, the same showing the columella and the thin edge of the outer lip; *c*, an advanced stage, view of back (the apex is already sinking, and the thickened lips are formed); *d*, still further advanced (the mantle has begun to secrete the enamelled spotted coat on the side, but the transverse stripes are still visible); *e*, the perfect shell, all traces of the transverse stripes lost under the enamelling of the thickened spotted coat; *f*, view of under side of the perfect shell.

differs from it in the want of thickness of the shell and the spire being more distinct, and in the want of the dorsal line, which is usually distinct in the third or perfect state, where the last coat has been deposited, and the aperture is more plaited on both sides. The colouring, or at least the disposition of the colouring here, is a much more certain characteristic of species than either the general outline of form or size, the latter of which is exceedingly various. In this family I have often observed full-grown specimens of *C. Arabica* from one to three inches long; this peculiarity is attempted to be explained by Lamarck and others, who assert that when the animal has formed a complete shell, as it has not the faculty of enlarging its size, it is obliged to quit its shell and form a new one, in the same manner as the *Annulosa* cast their skins, and by that means the same animal forms many shells; but I believe there is not the slightest ground for this notion."

The *Cypræidæ* abound both in the Old and New World, but their greatest development both in point of size and number of species takes place in warm climates. A very few species are inhabitants of the European seas. The family are littoral, and are generally found under stones or rolled corals.

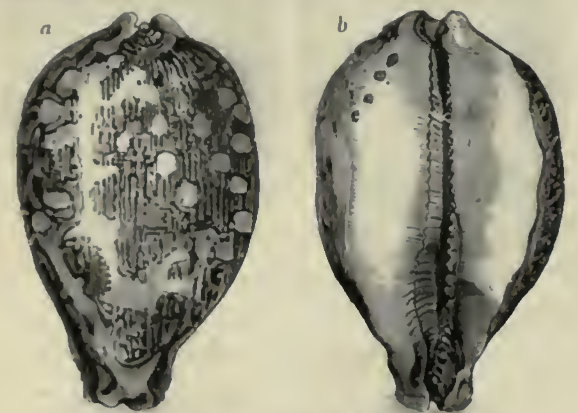
Genus *Cypræa*.—The young shell smooth, the adult with both lips toothed; the anterior and posterior canal distinct, recurved; the front end of the columella-lip smooth, edged by a single large oblique fold, separated from the teeth by a deep groove. (Gray.)

* Sub-Genus 1. *Cypræa*.—The front of the columella broad, deeply impressed; shell mostly smooth.

α. Shell smooth; columella-pit transversely ridged; teeth of inner lip generally long. (Gray.)

Under this division of the sub-genus Dr. Gray arranges 27 species, including some of the rarest forms—*C. aurora* (the Morning Dawn, or Orange Cowry), and *C. Princeps*, for example—together with *C. Tigris* (the Tiger Cowry), and other common species.

C. Mappa, the Map-Cowry. Shell more or less ventricose, ovate, varied with deep brown or yellow lines, and spots. Dorsal line laciniated. Margin thick, spotted with black; teeth yellow. It is found in the Indian Ocean.



Map-Cowry (*Cypræa Mappa*).
a, seen from above; *b*, seen from below.

There are many varieties, among which the rosy variety, the dark variety from the Pearl Islands, the citron variety, and the dwarf rich-mouthed variety from the Mauritius, are the rarest or most beautiful. The young shell is of a fawn colour with obsolete spots and dashes.

β. Shell smooth; columella-pit (nearly) smooth; teeth of inner lip short or indistinct.

Under this division of the sub-genus Dr. Gray arranges 15 species.

C. Talpa, the Mole-Cowry; Sardonyx Cowry of Gray. Shell oblong ovate, subcylindrical, yellowish, with three darker bands; the subangular base and teeth brown or black; mouth pale.

Mole-Cowry (*Cypræa Talpa*).

There is a variety (*Exustus*) shorter, darker, and with the teeth smaller and closer.

γ Shell with the back warty (rarely smooth), base ridged. Under this section Dr. Gray enumerates three species.

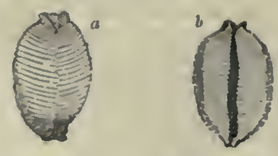
C. Cicercula, the Vetch-Cowry. Shell subglobose, yellow, brown, dotted, with a dorsal groove, and scattered tubercles over each extremity; base four-spotted, partly grooved.

Vetch-Cowry (*Cypræa Cicercula*).
a, seen from above; *b*, seen from below.

There is a larger variety which is more oblong, smooth, and is without the dorsal groove (*C. globulus*).

δ Shell with transverse ribs. Only two species are enumerated by Dr. Gray, and one of these, *C. rugosa*, Brod., is fossil.

C. Childreni, Children's Cowry, Gray.



Children's Cowry (*Cypræa Childreni*).
a, seen from above; *b*, seen from below.

ε Shell with longitudinal and transverse ribs.

C. Adamsonii, Adamson's Cowry, Gray, a very rare species, is the only representative of this group. Shell ovate; pear-shaped, white, brown mottled. It is a native of the Pacific Ocean (?). (Gray.)

Adamson's Cowry (*Cypræa Adamsonii*).

** Sub-Genus 2. *Aricia*.—Front of the columella flat, or nearly so; back of shell smooth.

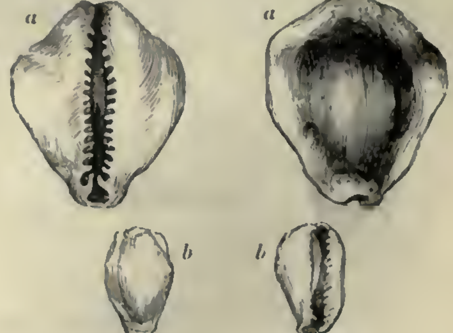
α Margin of the shell pitted on the upper edge. Fourteen species.

C. guttata, Gmel.; Blotched Cowry, Gray. Brown, pale spotted, base and margin white, brown-ridged: a beautiful and rare species. Locality, Red Sea (?). (Gray.)

Blotched Cowry (*Cypræa* (*Aricia*) *guttata*).

β Margin entire; teeth of both lips extended more or less over the base. Thirty-seven species.

C. Moneta, Money-Cowry, Linn. Shell yellow or white, with a yellow ring; margin and base tubercular; teeth of inner lip moderate.



Money-Cowry (*Cypræa* (*Aricia*) *Moneta*).
a, adult; *b*, young.

There are two varieties: *a*, without a ring; *b*, with the margin and base less tubercular.

The young are whitish with two dark bands (*C. icterina*).

γ Margin entire; teeth of inner lip very small, forming a slight ridge; front of columella-lip slightly concave, produced, and toothed internally. Two species.

C. angustata, Gray. Shell whitish brown, minutely brown dotted; base white; margin closely black dotted, ends blackish. Worn plain brown, varying in darkness. It is found in Australia.

Cypræa (*Aricia*) *angustata*.

*** Sub-Genus 3. *Naria*.—Front of the columella narrow, dilated into a sharp-toothed ridge; shell smooth.

This sub-genus is represented by one species.

C. irrorata, Gray. Shell ovate, purplish, yellow dotted; base white, flat; teeth large. It is a native of the South Seas. Most allied to *C. Felina*, variety 1.

Cypræa (*Naria*) *irrorata*.

Genus *Luponia*.—Shell like Cowry, but front end of the columella-lip crossed by several irregular ridges, without any distinct marginal one, internally narrow, flat; shell pear-shaped, smooth, or cross-ribbed. There are five species.

L. Algoensis, Algoa Lupon, Gray. Shell pale, brown dotted; base smooth; teeth of inner lip very small; margin black dotted. Variety with the teeth more or less obliterated. It is a native of the Cape of Good Hope.

Algoa Lupon (*Luponia Algoensis*).

Cypræovula.—Like Cowry, but front end of columella covered with regular cross-ribs, like rest of base, internally produced into an acute-toothed ridge. Shell pear-shaped, cross-ribbed.

C. Capensis, Cape Cypræovula, Gray. Pale brown; ribs very thin, continued, sharp. It is found at the Cape of Good Hope, but is very rare.

Cape Cypræovula (*Cypræovula Capensis*).

Trivia.—Like *Cypræovula*, but front of columella internally concave, ribbed. Shell subglobular, cross-ribbed.

a. Mouth wide; outer lip slightly inflexed; shell equally ribbed. In this section there are five species.

T. carnea, Flesh-Coloured Pig, Gray. Shell oblong, thin, pellucid, pure rose-coloured, with very thin distant continued ribs; lips whitish. Varies with an indistinct dorsal groove.

Dr. Gray observes that Pig is the common name of these shells on the coast, and that they are called Porcelli in Italy. He adds, that Porcellain, the common name for Cowries, is taken from the fancied resemblance of these shells to pigs, and refers to Fabius Columna, &c.

Flesh-Coloured Pig (*Trivia carnea*).

β. Mouth narrowish; outer lip wide; ribs of back subequal, linear. This section contains eighteen species.

T. Europæa, European Pig, Gray; *Cypræa Europæa*, Lam. Shell ovate, subglobose, ash- or flesh-coloured, with three black dots, and a whitish dorsal streak; ribs close, rather thick, whitish; base white; outer lip wide.

European Pig (*Cypræa* (*Trivia*) *Europæa*).
a, adult; *b*, young.

There is a variety with the back spotless, with an indistinct dorsal groove (*Cypræa Arctica*, Mont.). This shell is found on the British coast. It ranges from the verge of low water to as deep as 50 fathoms. It is also found in the coralline and red crag.

The young are white and smooth.

γ. Mouth narrowish; the outer lip arched; the ribs enlarged or tubercular near the dorsal groove. It contains seven species.

T. Pediculus, Louse-Pig, Gray; *Cypræa Pediculus*, Linn. Shell ovate, pale reddish, with six square black dorsal spots: ribs rather thick, subrugose, crowded; dorsal line narrow; base reddish. It is a native of the West Indies.

Louse-Pig (*Trivia Pediculus*).

δ. Mouth narrow; ribs tubercular; dorsal line distinct; front of columella smooth. In this section there are two species.

T. pustulata, Pimpled Pig, Gray; *Cypræa pustulata*, Lam., commonly called by collectors the Small-Pox Cowry. Purplish-brown; ribs studded with red-brown, black-edged warts. It is a native of the Pacific Ocean.

Small-Pox Cowry (*Trivia pustulata*).

Erato (Risso).—Spire conical; apex sub-mamillary, blunt; shell, when young, smooth; the adult with both lips finely crenulated; the columella concave, slightly radiatedly plaited or smooth, with two or three folds in front; the anterior canal straight, the hinder indistinct. This genus includes seven species.

E. scabriuscula, Roughish Tear-Shell, Gray; *Marginella Cypræola*, Sow. Shell ovate, turbinate, livid, purplish, minutely tubercular; spire conical; dorsal line impressed; mouth wide, whitish, inner lip largely plaited its whole length; teeth large; young, smooth; lip thin, toothless. It is found in the South Pacific, St. Helena.

Roughish Tear-Shell (*Erato scabriuscula*).

Ovulum (*Ovula*, Lam.).—The shell, when young, spirally striated when adult, covered with a smooth enamelled coat; the inner lip toothless; the outer toothed or crenated; the anterior and posterior canal more or less elongated.

α. The outer lip broad, inflexed, rounded, crenulated; extremities short; front of columella rounded.

In this subdivision Dr. Gray enumerates two species.

O. ovum; Ovula oviformis, Lam.; *Bulla ovum*, Linn.; Common Poached Egg. White; back rounded; inside orange-brown.

Common Poached Egg (*Ovulum ovum*), adult.

β. Outer lip inflexed, broad, toothed; ends short, curved, hinder end with a tooth on the inner side; front of the columella expanded beneath. One species only.

O. verrucosum; Ovula verrucosa, Lam.; *Bulla verrucosa*, Linn.; Two-Warted Poached Egg, Gray. Shell ovate; back angular; extremity rosy, with a depressed wart above. Young closely striated; ends brown-edged. Found in the Indian Ocean.

Two-Warted Poached Egg (*Ovulum verrucosum*).

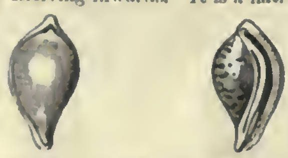
γ. Outer lip inflexed, rounded, narrow, toothed; rest like sect. β. It includes four species.

O. Margarita, Sow.; Pearl Poached Egg, Gray. Shell ovate, subglobose, white, pointed in front, ventricose; base convex; hinder tubercle rugose; front of columella concave; outer lip rounded. This with six brown dots artificially made is *Ovula punctata* of Duclos. A native of the Friendly Islands.

Pearl Poached Egg (*Ovulum Margarita*).

δ Outer lip slightly inflexed, narrow, keeled externally, with edge shelving inwards; the rest like the former. This section includes seven species.

O. pyriforme, Sow.; Pear-Shaped Poached Egg, Gray. Shell pear-shaped, yellowish-white, attenuated in front; front of columella concave; outer lip shelving inwards. It is a native of Australia.



Pear-Shaped Poached Egg (*Ovulum pyriforme*).

ε. Outer lip thickened, inflexed, toothless; extremities short; front of the columella flattened; hinder part with a fold obliterated by age. In this section there are nine species.

O. gibbosum; Ovula gibbosa, Lam.; *Bulla gibbosa*, Linn.; Gibbous Poached Egg, Gray. Shell oblong, blunt, white; margin yellow, covering nearly the whole shell; back with an angular rib. Varies in length and breadth. Found in the Atlantic Ocean.

Gibbous Poached Egg (*Ovulum gibbosum*).

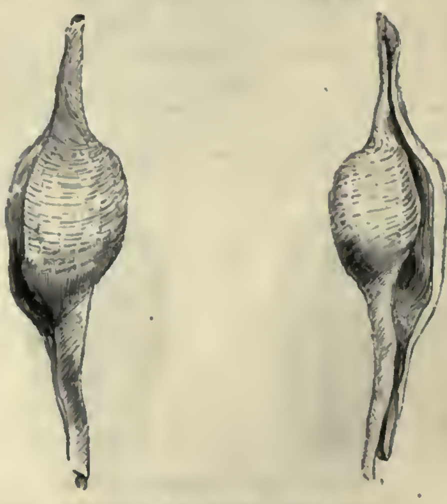
ζ. Outer lip thickened, inflexed, toothless; extremities rather elongated; the hinder conical, straight; the rest like the former. Four species are included in this section.

O. longirostratum, Sow.; Goodhall's False Spindle, Gray. Shell fusiform, white, thin; beak very long, curved; mouth linear, rather expanded in front. Found in the Adriatic.

Goodhall's False Spindle (*Ovulum longirostratum*).

η. Outer lip thickened, slightly inflexed, toothless; the front of the columella rounded, the extremities very long. (*Volva*, De Montf.) It embraces one species only.

O. volva; Ovula volva, Lam.; *Bulla Volva*, Linn., Common Weaver's Shuttle. Shell oval, flesh-coloured, striated; outer lip pink; the beaks long, flexuous. Locality, China.



Common Weaver's Shuttle (*Ovulum volva*).

On the position of this family amongst the *Mollusca*, Dr. J. E. Gray makes the following remarks:—"This family appears to be allied to the sub-family *Cassideæ*, amongst the *Buccinöideæ*, by means of the *Cassis Testiculus*, of which Lamarck observes, 'ce casque a un peu l'aspect de certains *Cypræa*;' but the affinity is not slight, for in the shape and form of the aperture, which has a groove or canal at each end, both of the lips plaited, and the front part of the columella flattened, it accords with those *Cypræa*; but the outer lip is not inflected, nor is the back of the shell covered with a china-like coat, but with epidermis, and the canal in front of the aperture is recurved. The *Ovulæ*, on the opposite side of the family, have certainly great affinity to the *Bullideæ* (*Bullidæ*), as is pointed out by Linnæus, who places them all in that genus, but *Bulla* differs most essentially from them: in the animals, by the position of their branchiæ and their being half hermaphrodite, and in the shell, by the aperture being rounded and quite entire at each end, and the edges not being thickened, nor the back covered with a shelly coat, for the shell is here covered with the soldered reflected lobes of the mantle; the connection is most apparent by means of *Ovula patula* and *Bulla Naucum*, in the latter of which there are some slight appearances of a curved canal at each end of the aperture, as in the character of the *Cpyrœideæ* (*Cypræidæ*), but it has not the enamelled back.

"This family has some analogy, in their polished coats, first to the *Marginellæ*, which induced Montagu to call a species of that genus *Cypræa voluta;* and indeed, such is the affinity between the young of this species, which has been called *Bulla diaphana*, that Dillwyn has considered it as the young of *Cypræa Europæa*; in which Montagu appears also to have coincided, until he observed a totally different construction in the animal: but I believe that *M. persicula* is the most analogical species of this genus; and secondly, to the *Olivæ*, which differ essentially in having an operculum, and all the characters of the *Buccinoideæ* (*Buccinidæ*)."

Messrs. Forbes and Hanley in their 'History of the British Mollusca,' place them after the *Conidæ*, and last of the families of the *Gasteropoda Prosobranchiata*.

Fossil Cypræidæ.

Fossil shells of this family do not appear to have been found below the Supracretaceous Group. Mr. G. B. Sowerby, speaking of the genus *Cypræa*, says, "Of these," the fossils, "we have several species in Britain, in the London Clay and Crag; many others are found on the Continent, as in the Calcaire Grossier in the environs of Paris; at Laugnan, near Bordeaux, and in Normandy; also in Italy and Piedmont; we have seen specimens of a very fine fossil species, nearly resembling *Cypræa mus*, from the Netherlands: they seem to be confined to the newer formations." Lamarck enumerates 18 fossil species of *Cypæa*, and two of *Ovulum*. Deshayes, in his 'Tables,' makes the number of living *Ovula* 18, and the number of fossil (tertiary) species 6. Three species, *O. Spelta*, *O. birostre*, and a new species, he makes both fossil (tertiary) and living in the Mediterranean, the Indian Ocean, and the Mediterranean respectively. The number of living species of *Cypræa* he makes 138, and the number of fossil (tertiary) 19.

Dr. Gray notes the following as fossil:—

Cypræa Physis, Brocchi (*C. Pyrula*, Lam.), Plaisantin or Placentin; *C. leporina*, Lam.; *C. gibbosa*, Gray; *C. tumidula*, König, Bordeaux: and he observes, that *C. annularia*, Brogn., appears to be an allied species; *C. fragilis*, Gray; *C. Deshayesii*, Gray; *Ovula tuberculosa*, Duclos; *C. inflata*, Lam., Grignon, allied to *Ovulum; C. subrostrata*, Gray, Nehove; *C. fabagina*, Lam.; *C. diluviana*, Gray; *C. rugosa*, Brod., Turin.

Luponia elegans, Gray (*C. elegans*, Defr.); *L. dactylosa*, Gray; *C. dactylosa*, Lam.; *C. Gervillii*, Sow.; *C. Georgii*, Defr.

Trivia Barcinensis, Gray (*C. Barcinensis*, König, Barcelona); *T. sphæriculata*, Cyp. Lam. (?), Italy; *T. acuticostata*, Gray, Italy; *T. pediculoides*, Gray, Italy; *T. Porcellus*, Gray, Crag (?); *T. Bronnii*, Gray, Italy; *T. solida*, Gray; *T. avellana*, Sow., M. C., Suffolk Crag, which, Dr. Gray observes, appears to be an allied species; *T. Duclosiana*, Gray.

Erato ventricosa, Gray, Italy.

Ovulum Lethesii (*Leathesii ?*), Sow., M. C.

The following species are described in Mr. Searles Wood's account of the Crag *Mollusca* (Pal. Soc.):—*Cypræa avellana; C. affinis; C. Anglicæ; C. retusa; C. Europæa; Erato lævis; E. Maugeriæ.*

CYPRESS. [CUPRESSUS.]

CYPRICARDIA. [SUBMYTILACEA.]

CYPRINA. [VENERIDÆ.]

CYPRINE. [IDOCRASE.]

CYPRI'NIDÆ, a family of Fishes of the section *Malacopterygii Abdominales*, the species of which are distinguished by their having the mouth small, formed by the intermaxillary bones, and generally devoid of teeth; the pharyngeans furnished with strong teeth, the branchiostegous rays few in number, and the scales generally of large size.

The principal genera belonging to this family are—*Cyprinus, Barbus, Gobio, Tinca, Cirrhinus, Abramis, Labeo, Catastomus, Leuciscus, Gonorhynchus, Cobitis, Anableps, Pœcilla, Lebias, Fundulus, Molinesia*, and *Cyprinodon.*

Cyprinus, as now restricted, contains the Common Carp and allied species, which are distinguished from those of the other genera above enumerated by their having one long dorsal fin, a small mouth devoid of teeth, the scales of large size, and the second rays of the dorsal and anal fins large, bony, and more or less serrated; branchiostegous rays three in number.

C. Carpio, Linn., the Common Carp, was introduced into this country at an early period (probably between the 14th and 15th centuries), but neither the date nor the country from which it was imported is precisely known. In Jenyns's 'Manual of British Vertebrate Animals' it is said to be originally from the middle of Europe; and since it thrives best in this part, such is probably the case. It now inhabits most parts of Europe, and in some places its growth is much attended to for the purposes of traffic. It frequents lakes, ponds, and rivers; in the last however it avoids those parts where the current is strong, preferring still water.

The food of the Carp consists chiefly of vegetable substances, which are masticated by means of the flat teeth which are situated on the pharyngeans; the larvæ of insects and worms however also afford it nutriment. This fish is of an elongate form, and rather thick; the back is considerably elevated, and the greatest depth of the body, which is beneath the commencement of the dorsal fin, measures rather more than one-third of the entire length: the head is large, and the mouth small in proportion; the lips are furnished with two barbules on each side, situated near the corners of the mouth: the dorsal fin commences in a line with the end of the pectorals, and occupies a space nearly equal to one-third of the entire length; the first ray is short and bony; the second is also bony but long, and serrated on the hinder part; the third ray is the longest, and is flexible, as are likewise the remainder of the rays: the anal fin terminates in a line with the dorsal, and like that has the two foremost rays bony and the second serrated; the pectoral fin has its origin immediately behind the free edge of the operculum; the caudal fin is forked, and the longest rays are double the length of those in the centre. The number of fin-rays are—dorsal, 22; pectoral, 17; ventral, 9; anal, 8; and caudal, 19. The lateral line is straight.

The general colour of the upper parts is a rich olive-brown, which is darkest on the head; the under parts are yellowish white, and the fins are brown; the ventral and anal fins are tinged with red.

As regards the size and weight of the Carp, we extract a few lines from Mr. Yarrell's valuable work. "Though not so rapid in their growth as some fish," says this author, "carp have attained three pounds' weight by their sixth year, and six pounds' weight before their tenth year. The largest I can refer to are thus noticed in Daniel's 'Rural Sports:'—'Mr. Ladbroke, from his park at Gatton, presented Lord Egremont with a brace that weighed thirty-five pounds, as specimens to ascertain whether the Surrey could not vie with the Sussex carp.' In 1793, at the fishing of the large piece of water at Stourhead, where a thousand large brace of killing carp were taken, the largest was thirty inches long, upwards of twenty-two broad, and weighed eighteen pounds.

"At Weston Hall, Staffordshire, the seat of the earl of Bradford, the painting of a carp is preserved, which weighed nineteen and a half pounds. This fish was caught in a lake of twenty-six acres, called the White Sitch, the largest of three pieces of water which ornamented this fine estate."

Carp are in season for the table from October to April.

C. gibelio, Bloch, the Prussian Carp, is another species of this genus now naturalised in this country, and which is said to have been introduced from Germany.

This species is considerably less than the Common Carp; its usual weight is about half a pound; it has been known however to weigh upwards of two pounds.

The Prussian Carp may at once be distinguished from the Common Carp by the absence of barbules on the lips. The greatest depth of the body is equal to one-third of the whole length, the tail included; the lateral line descends in a gentle curve from the upper angle of the operculum below the middle of the body, whence it is straight; the tail is forked; the longest rays are about one-third longer than the shortest rays; the dorsal and anal fins have a strong bony ray, as in the Common Carp, but these rays are not so deeply serrated. The number of fin-rays are—dorsal, 18; pectoral, 14; ventral, 9; anal, 8; and caudal, 19.

The colour of the upper parts is olive brown; the belly is almost white; the cheeks and gill-covers are of a brilliant golden-yellow hue; the fins are for the most part of an orange-red colour.

This fish is found in some of the ponds in the neighbourhood of London, and in other parts of England, but is rather local.

C. auratus (Linn.), the Gold Carp. The gold and silver fish, as it is termed, has been long known in this country: it is a native of China, and, according to Pennant, was first introduced into England in 1691, but was not generally known till 1728. The Gold Carp is now completely naturalised, both here and in other parts of Europe, where it has been introduced, and breeds freely, especially in ponds in warm and sheltered situations. In many of the streams of Portugal it abounds, whence they are brought over to this country in the trading vessels for sale.

This fish is too well known to require description. It is subject to much variation not only in colour but in the fins, which are sometimes double, and not unfrequently have triple tails; in the latter case however it appears that the tail is thus developed at the expense of part or the whole of some other fin. When young, the Gold Carp is of a very dark colour, approaching to black; this dark colour is replaced by the golden-red hue more or less early according to the constitution of the individual.

Of all fish the Gold Carp is most easily domesticated, and it may be kept for years in small glass vessels if care be taken to change the water every day in the summer, and twice or three times a week in the winter. Even this is not necessary if they are kept in vessels in which water-plants are permitted to grow, and a few fresh-water snails are added. In this way most of our fresh-water fish can be reared and treated, as pets in the drawing-room. [AQUAVIVARIUM.]

C. carassius, the Crucian or German Carp. This species was formerly confounded with *C. gibelio*. The following is Mr. Yarrell's description :—"The length of the head is to the depth of the body as 1 to 2; and to the whole length of head, body, and tail as 1 to 5; the depth of the body compared to the whole length as 2 to 5; the tail nearly square at the end."

This fish is much more rare than the Prussian Carp. Mr. Yarrell says he has never seen this fish except "from the Thames between Hammersmith and Windsor, where it attains considerable size, sometimes weighing a pound and a half; in one instance a specimen brought me in October 1829 weighed 2lbs. 11 ozs. Of its habits little is known."

In addition to the above species of *Cyprinus*, the following British fish belong to this family :—

Barbus vulgaris, Cuvier (*Cyprinus vulgaris*, Linn.), the Barbel. [BARBEL.]

Gobio fluviatilis, Cuvier (*Cyprinus Gobio*, Linn.), the Gudgeon. [GOBIO.]

Tinca vulgaris, Cuvier (*Cyprinus Tinca*, Bloch.), the Tench. [TINCA.]

Abramis brama, Cuvier (*Cyprinus brama*, Bloch.), the Bream, or Carp-Bream.

A. blicca, Cuv. (*Cyprinus blicca*, Bloch.), the White Bream or Bream-Flat.

A. Buggenhaggii, Thompson (*Cyprinus Buggenhaggii*, Bloch.), the Large-Scaled or Pomeranian Bream. [BREAM.]

Leuciscus Idus, Cuvier (*Cyprinus Idus*, Linn.), the Ide.

L. rutilus, Cuvier (*Cyprinus rutilus*, Linn.), the Roach.

L. vulgaris, Cuvier (*Cyprinus leuciscus*, Linn.), the Dace, Dare, or Dart.

L. Lancastriensis, Yarrell (*Cyprinus Lancastriensis*, Shaw), the Graining.

L. cephalus, Fleming (*Cyprinus cephalus*, Linn.), the Chub or Skelly.

L. eryothropthalmus, Cuvier (*Cyprinus eryothropthalmus*, Linn.), the Red-Eye, or Rudd.

L. cæruleus, Yarrell, the Azurine, or Blue Roach.

L. alburnus, Cuvier (*Cyprinus alburnus*, Linn.), the Bleak or Blick.

L. phoxinus, Cuvier (*Cyprinus phoxinus*, Linn.), the Minnow, Minim, or Birk. [LEUCISCUS.]

Cobitis barbatula, Linn., the Loach, Loche, or Beardie.

C. tænia, Linn., the Spined Loach, or Groundling. [COBITIS.]

CYPRINUS. [CYPRINIDÆ.]

CYPRIPE'DIUM, a genus of Plants belonging to the natural order *Orchidaceæ*, and the tribe *Cypripedieæ*. It has a patent perianth; a ventricose inflated lip; column trifid above; the lateral lobes bearing stamens, the middle lobe sterile, dilated; the two lower sepals combined; the germen straight.

C. calceolus, Lady's Slipper, has a leafy stem; the middle lobe of the column nearly ovate, obtuse, deflexed; the lip slightly compressed, shorter than the calyx. This plant has been found in Great Britain, but is extremely rare.

All the species are exceedingly elegant plants. They are mostly inhabitants of North America and Northern India. Two new species have been lately introduced. In their cultivation they require great care. They will only thrive in a shady border in peat soil. The American species should be covered with some dry straw in very severe frosts, or if there should be too much wet; they are not easily increased, but will perfect seeds in favourable situations, particularly if pains be taken to apply the pollen to the stigma.

(Babington, *Manual*; Loudon, *Encyclopædia of Plants*.)

CYPRIS. [BRANCHIOPODA.]

CYPSELAS. [HIRUNDINIDÆ.]

CYRENA. [VENERIDÆ.]

CYRILLACEÆ, *Cyrillads*, a natural order of Exogenous Plants. The order consists of shrubs with evergreen simple leaves without stipules. The flowers usually in racemes. The calyx 4-5-parted. It has 5 distinct petals, with an imbricated æstivation. The ovary is 2-3-4-celled, always composed of some number of carpels different from that of the calyx, corolla, and stamens; solitary pendulous ovules, a short style, the stigma with as many lobes as there are cells of the ovary. The fruit is a succulent capsule or a drupe; the seeds inverted; the embryo in the axis of a very large quantity of albumen, with a very long superior radicle. This order is related to *Olacaceæ* and *Pittosporaceæ*. All the species are inhabitants of North America. Nothing has been recorded of any uses to which they are applied.

CYRTANDRA'CEÆ, a small natural order of irregular-flowered Monopetalous Exogens, allied to *Bignoniaceæ* and *Gesneraceæ*. They are herbaceous plants, and in many cases stemless, with no tendency to twine; sometimes they are parasitical; their calyx, corolla, and stamens are those of *Bignoniaceæ*; but their fruit is a long slender pod, containing a multitude of seeds, that are terminated by long delicate tails, and are destitute of albumen. The pod is 2-celled, and each cell has its placentæ doubled back from the axis so as to form two plates at right angles with the dissepiment. The species inhabit the East Indies chiefly, a few only being met with in other warm parts of the world. They are all beautiful in their flowers, but they are of no known use. In his 'Vegetable Kingdom,' Dr. Lindley includes these plants in the order *Gesneraceæ*. [GESNERACEÆ.]

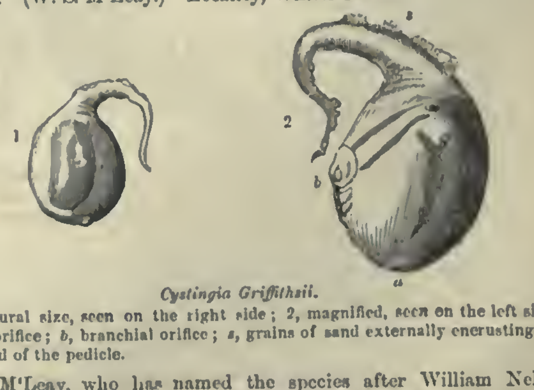
Streptocarpus Rexii.

1, a section across the ripe pod, showing the double placentæ.

CYRTO'CERAS, a genus of Fossil *Cephalopoda* belonging to the family *Ammonitidæ*, proposed by Goldfuss. It occurs in the Palæozoic Strata of Devon, the Eifel, and Ireland principally, and includes many species of great beauty and interest. The septa are pierced by a subdorsal siphon; the last whorl finishes in a straight extension. (*Phil. Pal.*, '*Foss. of Devon*.')

CYSTI'NGIA, a genus of Tunicated Ascidian *Mollusca*, established by Mr. W. S. M'Leay, who observes that it comes nearer to *Boltenia* than to any other hitherto described; and that they may prove eventually to be only two sub-genera, of which we want the intervening links to enable us to form an accurate notion of the genus to which they belong. It has the following characters :—Body with a subcoriaceous test, affixed by the summit to a very short pedicle, which is in the same line with the two orifices. The branchial orifice quadrifid and lateral, the anal irregular and terminal; both being so little prominent as not to alter the form of the body. Branchial pouch membranaceous, indistinctly reticulated, and divided into longitudinal folds. The tentacula of the branchial orifice composite. Intestinal canal lateral. Stomach very large, extending almost the whole length of the body. Ovaries two, composed of globular ova disposed in free racemes on each side of the body, with the branchial pouch and stomach between them. (W. S. M'Leay.)

C. Griffithsii has the envelope semipellucid, yellowish. Mantle very thin, and provided near the branchial and anal orifices with a reticulation of circular muscles nearly at right angles to each other. Tentacula about 10 or 12, compressed and laminated like those of the genus *Boltenia*. Branchial pouch having its net-work exceedingly lax, meshes irregular and indistinct, but apparently simple, the nervures being nearly of the same size. The longitudinal folds of the branchiæ, or rather (owing to the singular position of them in this genus) their transverse folds, about 14 or 15 in number. Length of the body, half an inch. (W. S. M'Leay.) Locality, Winter Island.



Cystingia Griffithsii.

1, natural size, seen on the right side; 2, magnified, seen on the left side *a*, anal orifice; *b*, branchial orifice; *s*, grains of sand externally encrusting the thick end of the pedicle.

Mr. M'Leay, who has named the species after William Nelson Griffiths, Esq., who found only one specimen during the third voyage under Captain (now Sir Edward) Parry, gives the following details of its organisation :—

"The body of this animal, so different in many respects from all other *Tethyæ*, is pyriform, and attached to a pedicle so short as scarcely to curve down farther than the branchial orifice. This pedicle is rather conical at its base, sub-cylindrical, and apparently very weak at its extremity. From this apparent weakness and imperfect formation of the pedicle, in conjunction with the circumstance of one side of the conical part in the only specimen that I have seen being incrusted with sand, I suspect that the animal can scarcely be said to be suspended by its pedicle, but rather reposes on the conical part of it; by which means the folds of the branchial pouch will take a vertical and the stomach a horizontal position, and thus be more in correspondence with the ordinary position of the stomach in the simple *Ascidiæ*, which is very rarely descending. The envelope of *C. Griffithsii* is exceedingly smooth, and so pellucid as to appear almost gelatinous. The original colour I cannot ascertain; but if it be the same as that of the specimen in spirits, it is cinereous, rather yellowish. The external orifices have scabrous veins, are very minute, and scarcely at all prominent. The branchial orifice is quadrifid, and placed exactly half-way down the side. The anal orifice is on the same line with it and the pedicle, but is placed opposite to this last, so as to be terminal, having its external surface apparently without rays; in both respects being totally different from the anal orifice of *Boltenia*."

Respiratory System.—"The entrance of the branchial cavity is provided with a circular range of 10 or 12 unequal tentacula, which are composite or divided into laciniæ at the extremity, which laciniæ are again so minutely divided as to be almost plumate. The branchial pouch has about fourteen folds, and its net-work is very indistinct and lax, the transverse nervures being perhaps the most visible, particularly towards the branchial orifice. The folds of the branchiæ are most easily seen on the inside of the branchial pouch."

Circulating System.—"The heart is situated horizontally between the lower part of the tunic and the stomach. It is large, ovoidal, and appears to be composed of several lobes, and is indeed of a structure different from that of such *Ascididæ* as are known.

"The dorsal sulcus is remarkably distinct, and proceeds from the immediate vicinity of the heart, or rather along the back of it to that of the branchial orifice. It may be seen through the external envelope of the body when this is viewed on the left side, and forms an arch inclosing a lesser and more pointed arch, which last appears to be nothing else than one of the folds of the branchial pouch. At the point where this last arch touches the dorsal sulcus there is in our specimen an orifice opening internally, and apparently communicating by a tube with a beautifully diaphanous longitudinal pouch, which contains nothing but two blackish nodules, one of which is longer than the other." The imperfection of the only specimen which M'Leay had for examination prevented him from accurately ascertaining the nature and use of this part of the organisation, which, he says, appears to have nothing similar to it in any of the other *Tunicata* hitherto observed.

Digestive System.—"The pharynx is situated rather higher than the branchial orifice; and the œsophagus, which is about half the length of the stomach, after descending to the highest part of the branchial vein, descends, and gives rise to a simple but enormous stomach, with very slight transverse striæ, and having a longitudinal division, marked somewhat deeply, and which runs almost the whole length of the body in a line between the base of the pedicle and the anal orifice. The intestine is exceedingly short, and apparently descending in a line with the stomach; the rectum is cylindrical, and anus simple. Such at least is the description of the digestive apparatus of this animal, if we give the name of pharynx to that end of the intestinal canal which opens into the branchial cavity, and the name of anus to that end of it which is free; and there is no doubt that such a description makes it an animal totally different from *Boltenia*, and in fact from all other species of *Tethyæ*, not only with respect to the singular form of the intestinal canal, but inasmuch as the branchial vein is thus placed, in relation to the pharynx, directly opposite to its position in all other animals of this group. I therefore am induced in some measure to suppose that there is a monstrous formation in the intestinal canal of the only specimen which I have had the means of examining; a supposition which must of course for the present throw doubt on any generic character which might be drawn from the above description of the intestinal canal. If indeed we could imagine that were it not for some monstrosity of structure, the intestinal canal would communicate with the branchial cavity by that end which, from its being free, I have been obliged to consider the anus, then the whole of the internal organs of nutrition would have a situation analogous to that of those of *Boltenia*. For instance, there would then be a short œsophagus opening near the anal orifice of the envelope, an ascending stomach, a long curved intestine, and descending rectum, while the branchial vein and heart would take their usual situation in respect to the pharynx and stomach. We know moreover, from those memoirs of Savigny, to which I have in the course of this paper had occasion to refer, that the digestive organs of the *Tunicata* are subject to analogous derangements, of which he has figured two remarkable examples in *Cynthia Momus* and *Phallusia Turcica*. It appears indeed to be a consequence of the low rank of these animals in the scale of being, and of their simple organisation, that the organs apparently most essential to their existence may undergo the greatest inversions without affecting their life; for the monstrous *Cynthia Momus* described by Savigny, as well as the *Cystingia* now under consideration, had its ovaries full of eggs."

Mr. Griffiths's specimen was taken in Fox's Channel, and two other specimens were obtained by the expedition under Captain Sir John Ross, near Felix Harbour; but as these were abandoned with the rest of the collection, it is probable, as Captain James Ross observes, that the individual from which Mr. M'Leay's description and drawings were taken is the only specimen ever brought to England.

CYSTIPHY'LLUM, a genus of *Madrephylliœa*, proposed by Lonsdale, to include species which have a vesicular internal structure, instead of clearly defined horizontal diaphragms and vertical lamellæ. It occurs in the Palæozoic Strata of Shropshire, Devon, and the Eifel.

CYSTO'PTERIS, a genus of Ferns belonging to the tribe *Aspidieæ*. It has the indusium attached by its broad hooded base under the sori, with a lengthened fringed free extremity, at first covering the thecæ.

C. fragilis, Brittle Fern, has bipinnate fronds; the pinnæ ovate-lanceolate; the pinnules ovate or ovate-lanceolate, toothed or pinnatifid. This is a remarkably variable species of fern. Three forms or varieties may be distinguished—*C. f. dentata*, with obtuse ovate pinnules, pointless, bluntly toothed or rarely pinnatifid, not decurrent; *C. f. angustata*, with pinnules linear, lanceolate, deeply and acutely pinnatifid or slightly toothed at the margin; the ultimate subdivisions oblong or linear, not dilated, rounded or ovate, sometimes notched at the end. The other form has the pinnules ovate, acute, pinnatifid, cut, and serrated, slightly decurrent. These plants are common in Great Britain, and found on rocks and walls, especially in limestone districts. They are of a diminutive size, and of a remarkably brittle nature, from which circumstance they have obtained their common name.

(Babington, *Manual of British Botany*; Newman, *History of British Ferns*.)

CYTACIS. [ACALEPHÆ.]

CYTHERÆA. [VENERIDÆ.]

CYTHERE, a genus of Entomostracous *Crustacea*, belonging to the legion *Lophyropoda*, the order *Ostracoda*, and the family *Cytheridæ*. The species are found very commonly in Great Britain. [BRANCHIOPODA.] Mr. Rupert Jones, in his 'Monograph of the Entomostraca of the Cretaceous Formation of England,' describes five fossil species belonging to this genus. [ENTOMOSTRACA.] The same author describes ten species of this genus as fossil in the Permian Rocks of England.

Cythereis is a genus separated from the group of species known as *Cythere*, by Mr. R. Jones. It has the following characters:—The animal is unknown. Carapace-valves or shell of an almost regular oblong shape, the dorsal and ventral margins lying nearly parallel to each other. Surface of a very irregular appearance, being wrinkled, ridged, and beset with tubercles, and crenulated or strongly toothed on the margins.

Dr. Baird has described three recent species, whilst nine fossil forms have been described by Mr. Jones from the Chalk.

Bairdia is a group of species formerly referred to *Cythere*, and separated by M'Coy. The valves externally are convex and smooth, sometimes finely pitted or spined, never ribbed or granulated; the hinge is simple.

This genus has no recent species. Six species have been found in the Chalk.

Cytherella, a genus separated by Jones from *Cythere*. It embraces species of *Cytherina* of other authors. The carapace-valves are oblong, and vary in the convexity and smoothness of the surface; the right valve is larger than the left, and its contact margin thicker than that of the opposite valve. Six fossil species have been described from the Chalk.

(Rupert Jones, *Monograph of the Entomostraca of the Cretaceous Formations of England*; W. King, *A Monograph of the Permian Fossils of England*, both published by the Palæontographical Society; Baird, *Natural History of the British Entomostraca*—Ray Society.)

CYTHEREIS. [CYTHERE.]

CYTHERELLA. [CYTHERE.]

CYTINA'CEÆ, *Cistus-Rapes*, a small natural order of Rhizanths, the type of which is *Cytinus Hypocistis*, a parasite found growing on the roots of certain kinds of *Cistus* in the south of France. Its stems are a few inches high, thick, succulent, reddish or yellowish, and covered by straight fleshy imbricated scales which are only abortive leaves. The flowers are nearly sessile, erect, arranged at the summit of the stem, yellowish and velvety on the outside. The relations of this order amongst the Rhizanths are evidently with *Rafflesiaceæ* and *Balanophoraceæ*. Like the Rhizanths generally they are also allied to *Fungi*, whilst their resemblance to certain Endogenous orders, as *Bromeliaceæ*, is evident. Griffiths regards the Rhizanths as reduced or degraded forms of Phænogamous Plants. The fruit is baccate, inferior, leathery, divisible into eight polyspermous lobes. The inspissated juice is used in French pharmacy as a styptic, but it is not admitted with us. Along with this genus are associated the curious genus *Hydnora*, Cape of Good Hope, which looks like a great star of the *Lycoperdon Apodenthus*, a minute parasite upon the branches of trees, and two other less known genera.

Cytinus Hypocistis.

1, a male flower; 2, a section of the same, very much magnified; 3, a female flower; 4, a section of the last.

CYTISUS, a genus of Plants belonging to the natural order *Leguminosæ*. It has a bilabiate calyx, the upper lip generally entire, the lower somewhat 3-toothed. The vexillum ovate and broad; the carina very obtuse, including the stamens, which are monadelphous. The legume is plano-compressed, many-seeded, not glandular. The species are small trees or shrubs, with ternate leaves and yellow-purple white flowers.

C. Laburnum, Common Laburnum, is a native of the mountains of Savoy and Switzerland. It is a small green branched tree. The young shoots are downy; the leaves on long stalks, leaflets rather glaucous, ternate, nearly sessile, oval, mucronulate, a little downy on the under side, the terminal one larger than the others; the petioles and subulate stipules downy. The racemes are pendulous, about 6 inches long, terminal, many flowered, frequent, and downy. The calyx campanulate, oblique, pushed inwards at the base, downy. The corolla large, and of a bright yellow colour. The legumes are downy, lineal, flat, thickened at each suture, rather contracted between the seeds. The seeds are oblong, compressed, shining, smooth, and of a deep greenish-black. They are highly poisonous, possessing narcotic acrid properties. The seeds of this plant are frequently sown in plantations infested with hares and rabbits, who will touch no other tree as long as a twig of Laburnum remains. Though eaten to the ground every season it rises again in the spring, thus affording a constant supply to these animals, so as to save other trees from their attacks.

C. Alpinus, Alpine Laburnum, has terete branches, petiolate leaves, ovate lanceolate leaflets, rounded at the base; pendulous recemes; pulverulous pedicels and calyces; glabrous few-seeded marginate legumes. It is a native of Carinthia, in groves. It is nearly allied to the *Laburnum*, but is distinct. The wood of both species is used by cabinet-makers on account of its hardness, durability, and beauty.

C. scoparius, Common Broom, is a large bushy shrub, with copious long, straight, angular, dark-green, smooth, tough branches. The leaves are deciduous, scattered, stalked, ternate, the upper ones generally simple, the leaflets uniform, obovate, obtuse, and entire; silky when young. The flowers are axillary, solitary or in pairs, on simple stalks, longer than the leaves, large and handsome, of a deep golden yellow, sometimes tinged with orange. The swelling ovary soon splits the tube of the filaments. The legume is brown, flat, above an inch long, nearly smooth at the sides, but fringed with harsh hairs at each margin. The *Cytisus* of Virgil was the *Medicago arborea* of botanists. For the medical properties of this plant see SCOPARIUS, in ARTS AND SC. DIV.

CYTOBLAST. In the development of the tissues of plants from the blastema, or cyto-blastema, which is a fluid consisting of water holding in solution sugar, gum, dextrine, &c., some of the granules assume a definite form, and become darker than the surrounding granules. These dark spots may be seen in the fluids of the growing parts of all plants. They are composed of some form of protein, and it is to these that Schleiden has given the name of Cytoblasts. The Cytoblast produces from its surface a cell: when the cell has become fully grown other Cytoblasts are produced in its interior, which, by producing other cells, burst the parent cell and increase the substance of the part in which they are found. A growing point of the same nature has been observed in the tissues of the animal kingdom, and it has been thus demonstrated that in the original growth of their tissues there is an identity between the animal and vegetable kingdoms. Although, when first made known by Schleiden, the Cytoblast was supposed necessary to the formation of every cell (and this led to the observation by Schwann of its extensive presence in the animal kingdom), it has since been pointed out by Mohl and others that the great mass of cells originates in the division of a protoplastic matter, which is not found in the form of a nucleus, but of a vesicle lining the interior of the cell. This substance has been called by Mohl the 'primordial utricle.' It is composed of the same material, and performs the same functions, as those attributed by Schleiden to the Cytoblast. Mr. Huxley proposes to call the proteinaceous formative matter originating each cell, under whatever form it occurs, the Endoplast. Thus the terms nucleus, protoplasm, primordial utricle, and endoplast may be regarded as synonyms of Cytoblast. [CELLS; TISSUES, VEGETABLE; TISSUES, ANIMAL; HISTOLOGY.]

CYTTARIA, a genus of Plants belonging to the natural order *Fungi*. One of the species, *C. Darwinii*, grows on the living branches of the South American beeches, and is described by Mr. Berkeley in the 'Transactions of the Linnæan Society.' It forms a principal part of the food of the natives of Tierra del Fuego during many months of the year.

D

DAB. [PLEURONECTIDÆ.]

DABCHICK. [COLYMBIDÆ.]

DABŒCIA (from St. Dabeoc), a genus of Plants belonging to the natural order *Ericaceæ*. It has a 4-parted calyx; the corolla oval, ventricose, the limb 4-toothed; 8 stamens inclosed, the filaments dilated, glabrous; the anther linear, sagittate at the base, the cells of the anthers parallel, loosened at the apex, dehiscing lengthwise; the stigma simple, truncate; the capsule 4-celled with a septicidal dehiscence. There is but one species, the *D. polyfolia*, which is a dwarf bushy evergreen shrub, a native of Ireland and the Pyrenees. This plant is the *Andromeda Dabœcia* of Linnæus, the *Erica Dabœcia* of Smith, the *Menziesia Dabœcia* of De Condolle, and the *Menziesia polyfolia* of Jussieu. In Ireland, which is its only locality in the British Islands, it is called Irish Whorts, Cantabrian Heath, and St. Dabeoc's Heath. It is a pretty shrub, and well fitted for decorating the fronts of shrubberies, or for rockwork. It may be propagated by dividing the whole plant, or by cuttings, or by layers. (Don, *Edinburgh Philosophical Journal*, vol. xvii.)

DACE. [LEUCISCUS.]

DACELO. [KINGFISHERS.]

DACNIS, Cuvier's name for a genus of Birds (the Pit-Pits of Buffon) which, he observes, represent the Carouges (*Xanthornus*) in miniature by their conical and sharp bill. *D. Cayana* is of a cerulean blue; forehead, shoulders, wings, and tail, black. It is a native of Mexico.

This pretty little bird is the Elotototl of the Mexicans. Hernandez says that it lives about the trees of the Tetzcocan Mountains; that it is eatable; that it does not sing, and that therefore it is not kept in the houses of the inhabitants.

Pit-Pit (*Dacnis Cayana*).

DACRYDIUM, a genus of Gymnogenous Plants belonging to the natural order *Taxaceæ*. One of the species, *D. taxifolium*, the Kakaterra-Tree of New Zealand, acquires a height of 200 feet. From its branches may be manufactured a beverage resembling in antiscorbutic qualities the well-known spruce-beer. (Lindley, *Vegetable Kingdom.*)

DACTYLIPORA. [POLYPIARIA.]

DACTYLIS, a genus of Plants belonging to the natural order of Grasses. *D. glomerata*, Cocksfoot-Grass, is an extremely common plant in fields and waste places, growing and flowering during a great part of the summer. It has in its wild state a coarse bluish rough herbage, and a flower-stem about three feet high, divided at the point into a loose panicle, each of whose divisions bears a cluster of flowers at its end. The glumes are 2, sharp-pointed, keeled, and rather unequal; they inclose from 3 to 6 florets, each of which consists of 2 rough-ribbed paleæ, the lower and outer of which is the broader, and tipped with a short bristle. In its uncultivated state this is a coarse hard grass; nevertheless it is readily eaten by cattle, horses, and sheep. It strikes its roots to a considerable depth in the soil, and on this account is capable of enduring the drought of dry sandy exposed land. Hence in such situations, where scarcely any other pasture can be procured, as in the naked brecks (or undulating downs) of Norfolk, it is of great value.

Mr. Sinclair assures us that Cocksfoot forms a part of the herbage of pastures most celebrated for fattening and keeping the largest quantity of stock in Devonshire, Lincolnshire, and the vale of Aylesbury; and he states that in the most skilfully managed of these pastures the foliage of the Cocksfoot was only to be distinguished by an experienced eye from the various species of fine pasture grasses with which it is combined. We would not however recommend any one laying down artificial grass to employ Cocksfoot where other grasses can be made to succeed, for we have invariably found it overgrowing the sorts with which it was mixed, and forming coarse tufts which neither feeding nor mowing has been able to keep down.

Cocksfoot Grass (*Dactylis glomerata*).
1, a spikelet much magnified; *a*, *a*, the glumes; 2, a floret with the paleæ.

DACTYLOPTERUS (Lacépède), a genus of Fishes belonging to the order *Acanthopterygii* and family *Loricati*. It has the following characters:—Head flattened, large, and long, and rising suddenly from the muzzle, which is very short; inferior angle of the pre-operculum furnished with an elongated strong spine; operculum without spines; mouth small; jaws furnished with masses of minute conical teeth; branchiostegous rays six in number; some of the anterior rays of the dorsal fin free; subpectoral rays numerous, very long, and connected by a membrane; ventral fins with four rays; body covered with hard carinated scales.

The fishes of this genus are classed with the gurnards; they may however be readily distinguished from the typical or true gurnards by the immense size of the pectoral fins.

In the true gurnards we observe three detached rays situated under the pectoral fins, but springing from the same base: in our present genus these rays are very numerous, immensely long, and connected by a membrane. By means of these large fins, the length of which is almost equal to that of the body of the animal, these fishes are enabled to sustain themselves in the air for several seconds, which they often do to escape from their enemies when pursued; but in quitting the waters to avoid their pursuers in that element, they not unfrequently fall a prey to the frigate-birds and albatrosses.

This genus contains but two species, one of which has been long known: it inhabits the Mediterranean, and is the *Trigla volitans* of Linnæus. It is commonly called the Flying-Gurnard and Flying-Fish; but there are other species of fish which have obtained this name, on account of their power of sustaining themselves for a few seconds out of the water. The other species inhabits the Indian Seas, and is the *Dactylopterus orientalis* of Cuvier.

Dactylopterus orientalis.

Dactylopterus volitans, the Flying-Gurnard, varies from 1 foot to 15 inches in length, and is of a brown colour above, with spots of a deeper tint: the sides of the body are red, and the under parts are of a pale rose-colour. The large pectoral fins are of a blackish tint, mottled and spotted with blue; the ventral and anal fins are of a rose-colour; the anterior dorsal is gray, with clouded markings of a deeper hue; the posterior dorsal is transparent, and its rays are of a pale colour, spotted with brown.

DADDY-LONG-LEGS. [TIPULA.]

DÆDALION. [FALCONIDÆ.]

DAFFODIL, the English name of *Narcissus Pseudo-Narcissus* and its allies, to which some recent botanists have given the generic name of *Ajax*. [NARCISSUS.]

DAGYSA. [SALPACEA.]

DA'HLIA, a genus of Plants belonging to the natural order *Compositæ*. Three species only are known, all natives of Mexico. Of these, two, *D. coccinea* and *D. Cervantesii*, were formerly cultivated in this country, but not sporting into varieties, and being much less beautiful than *D. variabilis*, they are not now seen in gardens. *D. variabilis* itself is, in its wild state, a bushy herbaceous plant, 7 or 8 feet high, with single purple or lilac flowers, and is by no means remarkable for its beauty. In cultivation however it is so readily improved in size and form, and sports into such endless varieties in stature, leaves, and flowers, that it has become the most extensively cultivated florist's plant of the present day. Its innumerable sorts are the glory of our gardens in the autumn, and are quite unrivalled at that season of the year: they are however destroyed by the earliest frosts. [DAHLIA, in ARTS AND SC. DIV.]

DAISY, or DAY'S EYE, the little perennial plant called *Bellis perennis* by botanists. Like most composite flowers, it has proved productive of varieties when domesticated; but they have almost disappeared, except from old-fashioned or cottage gardens. [BELLIS.]

DALBERGIA, a genus of Plants belonging to the natural order *Fabaceæ*, named in honour of Nicholas Dalberg, a Swedish botanist. It has a campanulate calyx, 5-toothed; a papilionaceous corolla, the petals of the keel connected to the apex; 8-10 stamens, sometimes all monadelphous, with the tube or sheath cleft in front, sometimes divided into two equal opposite bundles. It has a stipitate membranous compressed legume, which is flat, oblong, and tapers to both ends. The seeds, which vary from 1 to 3, are compressed and remote. The species are sometimes trees, but usually climbing shrubs, with impari-pinnate leaves.

D. Sissoo, has five alternate leaflets, glabrous above, pubescent beneath. It is a native of Bengal, where the timber is much prized, and is known by the name of Sissoo.

D. monetaria, another of the species, yields a resin very similar to Dragon's Blood.

There are about 22 species of this genus, none of which are of any known use except those mentioned.

DAMA. [CERVIDÆ.]

DAMALIS. [ANTILOPEÆ.]

DAMASK-ROSE. [ROSA.]

DAME'S VIOLET. [HESPERIS.]

DAMMARA, Dammer-Pine. [AGATHIS.]

DAMOMITE, a Mineral found in the United States. It is a hydrous silicate of alumina. [PREHNITE.]

DAMSON, or DAMASCENE (from Damascus), a race of plums cultivated in this country for the sake of their hardiness and prolific habits. They are a mere form of the domestic plum, from which there are no certain characters to distinguish them, except the abundance of their late oval fruit, and the property they possess of propagating by suckers. All the varieties are used for kitchen purposes principally, and are generally confined to the gardens of cottages or farm-houses, where the quantity of produce is more valued than its quality. Much the finest variety of this sort of plum is that called the Shropshire Damson, which is extensively multiplied in the nurseries by grafting. [PLUM, in ARTS AND SC. DIV.]

DANÆACEÆ, *Danæworts*, a small natural order of Plants related to the Ferns. They have all the habit of Dorsiferous Ferns, but their spore-cases are ringless and combined in masses, splitting irregularly by a central cleft. The species are all tropical. It embraces the following genera :—*Kaulfussia, Angiopteris, Danæa, Eupodium, Marattia*, and about fifteen species. *Angiopteris evecta* is said to be employed in the Sandwich Islands to perfume cocoa-nut oil. The rhizome of a species of *Marattia* is eaten by the Sandwich Islanders.

DANBURITE, an American Mineral. It occurs crystallised. Its primary form is an oblique rhombic prism. The colour honey-yellow, becoming nearly white by decomposition; streak white. Hardness 7·5. Lustre vitreous; translucent, transparent. Specific gravity 2·83. It is found at Danbury, Connecticut. The following is the result of an analysis by Shepard :—

Silica	56·
Lime	28·33
Alumina	1·7
Yttria	·85
Potash, Soda, and loss	5·12
Water	8· —100

DANDELION, a corruption of the French name Dent de Lion, or Lion's Tooth, a common weed, with a tapering milky perennial root, resembling that of succory. It is the *Leontodon Taraxacum* of botanists. [LEONTODON.]

DANEWORT. [SAMBUCUS.]

DAPE'DIUM, changed by Agassiz to *Dapedius*, one of the first described British genera of Fossil Ganoid Fishes. To *D. politum* of De la Beche ('Geol. Trans.,' 2nd series, vol i. pl. vi.) six others are added by Agassiz, all from the Lias.

DAPHNE, a genus of Plants belonging to the natural order *Thymelaceæ*, containing many species, inhabiting the more temperate parts of Europe and Asia. Among them some are cultivated in gardens for their beauty or fragrance, others are of medicinal importance, and a few are employed in the manufacture of hemp and paper. We shall briefly notice the more remarkable of these.

The genus *Daphne* is distinguished in its natural order by having 8 or 10 stamens inclosed within the calyx, a simple stigma, a succulent fruit, and a calyx, the orifice of whose tube is destitute of appendages.

D. Mezereum, the Mezereon of the gardens, is a deciduous plant, with white or purple fragrant flowers, sitting close to the stem, and appearing on the naked branches before the leaves are unfolded. It is a favourite in gardens, and succeeds in almost any well-drained light soil where the air is not poisoned by the smoke of coal-fires. It is found wild in the mountainous woods of many parts of the middle and south of Europe. It is met with in woods in various counties of England. The berries are smooth, shining, and bright red.

All the parts of this and indeed of the other species, as far as they have been examined, are extremely acrid and poisonous. If the bark is bruised and applied to the skin, it produces severe blisters, and is sometimes substituted for cantharides when that drug cannot be employed with safety. Taken internally, the bark, leaves, and fruit, act as cathartics, but require to be administed with extreme caution; for they are apt to produce dangerous and even fatal consequences. Linnæus speaks of a person having been killed by a dozen Mezereon berries; and they are employed in Sweden to poison wild animals. According to Fée, the very odour of *Daphne*, agreeable as it is, is attended with danger; he says that if kept in sitting-rooms they will bring on headache and fainting. It is moreover asserted that Russian and Tartarian women sometimes rub the berries of the Mezereon on their cheeks to produce a slight irritation, which of course gives the effect of rouge, only in a more permanent degree. (MEZEREON, in ARTS AND SC. DIV.)

D. Laureola, the Spurge Laurel, is another British species, found wild commonly in woods and hedges. It is a handsome evergreen bush, with the aspect of a laurel. The leaves are placed very close together; they are of a leathery consistence, deep green, lanceolate, acute, and narrowed to the base. The flowers are green, and grow in little short clusters, which are nearly concealed by the leaves. The berries are, when ripe, a deep purple black. We have no species that grows more readily beneath the shade of trees; and as its appearance is highly ornamental, it would be a most useful garden plant, if it were not for the dangerous berries, which children are apt to eat. An ointment for keeping open blisters is prepared from this plant.

D. pontica. One of the plants which is reputed to have contributed to the poisonous quality of the honey that was eaten by Xenophon's soldiers, is very like this species, and is often cultivated as a hardy evergreen.

D. Gnidium, the Garou-Bush, an evergreen with narrow sharp-pointed erect light-green leaves, and branching clusters of white fragrant flowers, is a common plant in dry waste places in the south of Europe. It will not live in the open air in England, except in the warmest counties. Both the berries and leaves are employed by the French as purgatives. The plant also affords a good yellow dye.

D. Cneorum, a native of grassy places in the Alps of Switzerland and the rest of Central Europe, with its trailing stems, numerous small narrow blunt deep-green leaves, and clusters of rich purple fragrant flowers, is one of the most beautiful of all plants, when it finds a soil and climate that suit it. At Bagshot, for instance, and in similar situations, it is under good management quite unrivalled by the other hardy shrubs among which it grows. It will not succeed where the soil is otherwise than sandy and peaty, nor can it bear the impure atmosphere of large towns.

D. collina, D. alpina, D. Neapolitana, and *D. Tarton-raira* are other species cultivated in gardens. The first has dull purple sweet-scented flowers, and is sufficiently common in collections; the others are rarer. All are impatient of wet in winter; but if at that season kept tolerably dry will bear considerable frost, and are desirable garden plants in the milder parts of England.

In addition to the acrid and dangerous properties which appear to be common to them all, some species are remarkable for the toughness of their fibre, and for the economical purposes to which they are applied. From *D. Cannabina* is prepared the best kind of writing-paper in China, according to Loureiro; but it must be observed that this statement, if true, is at variance with what is observed in Nepaul, where the daphne-paper is very brittle and bad.

D. Lagetta, the Lace-Bark-Tree of Jamaica, is most remarkable for the tenacity of the fibre of which its bark consists, and for the facility with which it may first be separated into thin layers and then into distinct meshes. If the inner bark of this plant be macerated in water it may be readily separated into layers no thicker than the finest lace, and which after having been pulled a little sideways resembles in some measure that fabric. King Charles II. is said to have had a cravat, frill, and ruffles of Lace-Bark presented to him by his governor of Jamaica.

DAPHNIA, a genus of Entomostracous *Crustacea*, belonging to the division *Branchiopoda*, the order *Cladocera*, and is the type of the family *Daphniadæ*. This genus is characterised by Baird as follows: Head produced downwards into a more or less prominent beak. Superior antennæ exceedingly small, 1-jointed, and situated under the beak; inferior antennæ large and powerful.

Several other genera have been formed out of the species that were formerly referred to the genus *Daphnia*. [BRANCHIOPODA.]

D. Pulex (Latreille), the Water-Flea, is the best known species of this genus. It is known by a multitude of names, the most common of which is the Water-Flea. The whole of the species however have this designation. The following are some of the synonyms :—

Monoculus Pulex, Linnæus.	*Daphne Pulex*, Müller.
Daphne pennata, Müller.	*Pulex arborescens*, Swammerdam.
Daphnia ramosa, Koch.	Puceron Branchu, Trembley.
Pou Aquatique, Joblot.	Le Perroquet d'Eau, Geoffroy.
Vermes minimi rubri, Bennett.	Animaletti Aquatici, Redi.

This little creature forms a beautiful object for the microscope. Its shell or carapace is transparent, and through it can be seen the whole of its interior organisation. The lower extremity of the valves terminates in a sharp spine, which is serrated at the edges. The head is large; the superior antennæ are very small, whilst the inferior antennæ are very large. The male is much smaller than the female, and is comparatively rarely met with. It is found commonly in ponds and ditches round London at all seasons of the year. It is frequent in the cisterns which supply the houses of London with water.

D. psittacea, Baird. It closely resembles the last species, but Dr. Baird says, upon close examination, "The form of the head and the serrated dorsal margin distinguish it very readily."

D. Schæfferi, is a larger species than *D. Pulex*. It is about the fifth of an inch in length and two lines broad. Their motion through the water is peculiar, being a tumbling wavy sort of movement. They remain at the bottom of the water. They are very much infested with species of *Vorticella*.

D. vetula is common round London, and has a smaller head than *D. Pulex*. It is the *D. sima* of Müller and *Monoculus simus* of Gmelin.

There are three other species noticed by Dr. Baird in his 'British Entomostraca.' *D. reticulata, D. rotunda*, and *D. mucronata*. The last is a rare species.

(Baird, *Natural History of British Entomostraca*.)

DAPILA. [DUCKS.]

DAPSUS, a genus of Coleopterous Insects. [EUMORPHUS.]

DAPTRIUS. [FALCONIDÆ.]

DAPTUS (Fischer), a genus of Coleopterous Insects belonging to the family *Harpalidæ*. It has the following characters :—Mentum deeply emarginated and without any tooth-like process in the middle; antennæ rather short, and moniliform; second joint of the labial palpi somewhat oval; four basal joints of the four anterior tarsi slightly dilated, short, and triangular; body more or less elongated, the elytra with their outer margins almost parallel.

D. vittatus is of a pale yellowish colour, with an oblong black spot on each elytron; the head and thorax are more or less clouded with brown or black in some specimens.

This species is about a quarter of an inch in length, and inhabits sandy districts in the vicinity of water in the southern parts of Russia and France.

D. incrassetus (Dejean) has the same colouring as the last, but it is of a larger size, being upwards of half an inch in length. It inhabits North America.

DARNEL. [LOLIUM.]

DA'RNIS (Fabricius), a genus of Insects belonging to the order *Hemiptera* and family *Cercopidæ*. The species of this genus have the posterior part of the pro-thorax prolonged so as totally to cover the upper part of the abdomen and wings, or nearly so: this portion of the pro-thorax is of the form of an elongated and arched triangle. [CICADELLA.]

DAROO-TREE is the *Ficus Sycamorus*, the Egyptian Sycamore. [FICUS.]

DART. [LEUCISCUS.]

DASYORNIS. [MERULIDÆ.]

DASYPROCTA. [AGOUTI.]

DASYPUS. [ARMADILLO.]

DASYURUS. [MARSUPIATA.]

DATE-PALM. [PHŒNIX.]

DATHOLITE, a Mineral which contains Boracic Acid, Silica, and Lime. It has been found at Arendahl in Norway, and a few other places. It occurs both massive and crystallised in rhombic prisms, the lateral edges and the solid angles of which are usually replaced by planes. The colour of *Datholite* is grayish or greenish white, and it is translucent. Its specific gravity is about 3. It yields to the knife. The fracture is imperfect conchoidal. The lustre is somewhat vitreous. According to the analysis of Vauquelin, it consists of

Boracic Acid	21·67
Silica	37·66
Lime	34·
Water	5·5
	98·83

DATISCA'CEÆ, *Datiscads*, a small natural order of Plants allied to *Begoniaceæ* and *Cucurbitaceæ*, and the other apetalous orders in their vicinity, but distinguished by its inferior ovary with parietal placentæ. It has unisexual flowers; the males have a calyx of several pieces, and from 8 to 15 stamens; the females have an obsolete superior calyx, and three little recurved stigmas at the apex of an oblong 1-celled ovary, with 3 many-seeded parietal placentæ. The seed-vessel opens at the end like that of *Reseda;* the seeds are

A male plant of *Datisca Cannabina*; A, a cluster of ripe fruit from a female plant.

inclosed in a finely netted bag, and contain a straight embryo without albumen. The order has 3 genera and 4 species. *Datisca Cannabina*, the commonest plant of the order, is an herbaceous diœcious perennial, with stems about 3 feet high, pinnated leaves with from 5 to 9 ovate-acuminate coarsely-serrated leaflets, and long racemes of flowers collected in clusters in the axils of long linear bracts. It is a native of the southern parts of Europe, where, especially in Candia, it is used on account of its bitter tonic properties as a substitute for Peruvian bark; it also affords a yellow dye.

DATU'RA, a genus of Solanaceous Plants, with a funnel-shaped angular 5-lobed calyx, a corolla of a similar form, but much larger, and a 4-celled capsule, which is either smooth or muricated externally; the base of the calyx moreover adheres to the seed-vessel in the form of a circular disc.

Several species of this genus are known in cultivation, the very large size of their funnel-shaped flowers rendering them conspicuous objects; they have however a nauseous odour, and are only handsome when in flower, for which reason they are not general favourites. They are all exotics, with the exception of the following, in whose properties they coincide.

D. Stramonium, the Thorn-Apple, is by no means an uncommon annual upon dunghills, rubbish-heaps, and waste-places near houses. It grows about 3 feet high, with a light-green stiff stout stem, which is slightly downy near the upper end. The leaves are broad, oval, stalked, sharp-pointed, sinuous, and angular. The flowers are large, white, or occasionally dull light purple, and grow singly from the side of the stem opposite the origin of the leaves; they are erect, and placed upon a very short peduncle. Their calyx is tubular, elongated, a little swollen at the lower end, with five prominent ribs, ending in as many sharp-pointed lobes; after flowering, it all drops off, except the base, which surrounds the fruit in the form of a circular disc. The corolla is much larger than the calyx, of a similar form, but its lobes are more taper-pointed. There are five stamens, which are inclosed in the tube of the corolla. The ovary is covered with small sharp points, and contains four cells, in each of which is a considerable number of ovules. The style is cylindrical, smooth, and enlarged at the upper end. The fruit is a spiny oval capsule of four imperfect cells, which communicate with each other in pairs. The seeds are brown, kidney-shaped, with a scabrous surface.

This plant is well known, under the name of *Stramonium*, as a powerful and dangerous narcotic. Its leaves and seeds are the parts employed, and they are found to possess properties similar to those of henbane and belladonna. The leaves are occasionally smoked, especially by country people, as a remedy for asthma; the seeds are employed by thieves to drug the beverage of their victims. In small doses they produce symptoms of frenzy; in larger quantities stupor and death. The poisonous principle of this and other species is considered a peculiar vegetable alkali, and called Daturine. [STRAMONIUM, in ARTS AND SC. DIV.]

D. arborea and *D. bicolor*, beautiful arborescent South American plants, the former with long white flowers, and the latter with yellow or scarlet ones, are noble objects in the gardens of this country. They participate in the properties of the true Daturas, but they are not now considered to be genuine species, on account of their calyx slitting on one side, and remaining permanent around the base of the fruit. They are stationed in a genus called *Brugmansia*.

DAUCUS, a genus of Plants belonging to the natural order *Umbelliferæ*. It has hispid fruit, of a somewhat compressed ovate or oblong form, the primary ridges filiform and quite bristly, the secondary ridges prominent, winged, and divided at the edge into a number of fine teeth or hooks. De Candolle enumerates 38 species, chiefly biennials, but it is doubtful whether several of them are not mere varieties of each other.

D. Carota, the only one to which general interest attaches, is the Carrot. This plant, which grows wild all over Europe in chalky soil, is believed to be the origin of our garden carrot, but there is no record of its having first begun to change its hard wiry juiceless wild root for the nutritious succulent carrot of the gardens. De Candolle gives for the range of the wild plant the meadows and pastures of Europe, the Crimea, and Caucasus, whence it has been transported into China, Cochin China, America, and elsewhere. [CARROT, in ARTS AND SC. DIV.]

D. gummifer is known by having its radical leaves triangular. It is found on the sea-coast of the south of England, and is also called *D. maritimus*.

DAVILLA, a genus of Plants belonging to the natural order *Dilleniaceæ*. It has 5 very unequal sepals, which increase after flowering; from 1 to 6 petals, with linear filaments dilated upwards. The single carpel is testaceous, from 1 to 2-seeded, inclosed in the two inner concave valve-like sepals. The seeds are solitary, enveloped in an arillus, which is only open at the apex.

D. elliptica has a shrubby erect much-branched stem, with hairy branchlets. The leaves are elliptical, obtuse at each end, entire, between crustaceous and leathery, rough and hairless above, downy and netted beneath; the petiole villous on the under side. The racemes are hairy and bracteolate; the sepals silky. The petals from 1 to 6, somewhat obcordate. This plant is an astringent, and furnishes the vulnerary called Sambaibinha in Brazil.

D. rugosa is also a native of the forests of Brazil, and has a twining stem with hairy twigs. The leaves are oblong, remotely and obsoletely serrated, rough and hairless above, shaggy beneath on the principal veins. The petioles are very shaggy beneath. The peduncles and pedicels hairy. It has two or three petals. Like the former species it is an astringent, and is used in swellings of the legs and different parts of the body in South America.

DAVITE, a name given to a Sulphate of Alumina, found in a warm spring which contains sulphuric acid, near Bogota in Columbia. It occurs massive, is of a fine fibrous structure, a white colour, and silky lustre. It is very soluble, and has a very astringent taste.

DAVYNE, a Siliceous Mineral, found in cavities in some of the masses ejected from Vesuvius. The primary form is a rhomboid, but it occurs in regular hexagonal prisms, with the terminal edges truncated. Its fracture is conchoidal; cleavage parallel to the planes of the hexagonal prism. It is transparent, colour white or yellowish-brown. Streak white, lustre vitreous, pearly upon the cleavage planes. Hardness, 5·0 to 5·5. Specific gravity, 2·4.

DAY-LILY. [HEMEROCALLIS.]

DEAD-MAN'S FINGERS [ALCYONIDÆ.]

DEAD-MAN'S TOES. [ALCYONIDÆ.]

DEAD-NETTLE. [LAMIUM.]

DEADLY-NIGHTSHADE. [ATROPA.]

DEAL-FISH. [TRACHYPTERUS.]

DEATH-WATCH. Every one has heard of the Death-Watch, and knows of the superstitious notion of the vulgar, that in whatever house its drum is heard one of the family will die before the end of the year. These terrors in particular instances, when they lay hold of weak minds, especially of sick or hypochondriac persons, may cause the event that is supposed to be prognosticated. A small degree of entomological knowledge however would relieve them from their fears, and teach them that this heart-sickening tick is caused by a small beetle giving a call to its companion.

Authors were formerly not agreed concerning the insect from which this sound of terror proceeded, some attributing it to a kind of wood-louse and others to a spider. The earliest scientific account of it is probably that by Mr. Benjamin Allen, written in 1695, and published in the 'Philosophical Transactions,' vol. xx. p. 376, where the writer calls it *Scarabœus galeatus pulsator;* followed, vol. xxii. p. 832, by another account from the celebrated Dr. William Derham, dated Upminster, July 21, 1701. Swammerdam ('Bibl. Nat.' edit. Hill, i. 125), and Shaw ('Nat. Misc.' iii. 104), have also written upon this insect. It is a received opinion now, adopted upon satisfactory evidence, that the sound called the death-watch is produced by certain beetles belonging to the timber-boring genus *Anobium*. Latreille observed *Anobium striatum* to produce the sound in question; but the species whose proceedings have been most noticed by British observers is *Anobium tessellatum*. When spring is far advanced these insects commence their ticking, which, as already mentioned, is only a call to each other, to which, if no answer be returned, the animal repeats it in another place. It is thus produced: raising itself upon its hind legs, with the body somewhat inclined, it beats its head with great force and agility upon the plane of position; and its strokes are so powerful as to make a considerable impression if they fall upon any substance softer than wood. The general number of distinct strokes in succession is from seven to nine or eleven. They follow each other quickly, and are repeated at uncertain intervals. In old houses, where these insects abound, they may be heard in warm weather during the whole day. The noise exactly resembles that produced by tapping moderately with the nail upon the table; and when familiarised the insect will answer very readily the tap of the nail. (Brand's 'Popular Antiq.'; Kirby and Spence's 'Introd. to Entomology,' edit. 1828, i. 36; ii. 382; Wallis's 'Hist. Northumb.' i. 367.) The superstition that the clicking of this insect is a death-omen is mentioned by Baxter in his 'World of Spirits,' p. 203.

This is only one of many instances in which natural occurrences have been regarded with superstition and terror, and is a good illustration of the folly and danger of referring material phenomena to spiritual causes.

DEATH'S-HEAD MOTH. [SPHINGIDÆ.]

DECAPODA. [CRUSTACEA.]

DEER. [CERVIDÆ.]

DEER-LIKE ANTELOPES. [ANTILOPEÆ.]

DELPHINAPTERUS. [CETACEA.]

DELPHI'NIUM, a genus of Plants belonging to the natural order *Ranunculaceæ*. It consists of annual or perennial herbaceous plants, with irregular spurred flowers, the colours of which are often of the most vivid blue. They are very nearly allied to the Aconites, from which they differ merely in their upper sepal being lengthened at the base into a spur instead of at the back into a helmet, and in the petals having no spur at all, but being deformed stalked bodies altogether different in form, and often in colour, from the sepals.

The species abound in the temperate parts of the northern hemisphere, and are often cultivated in gardens under the name of Larkspurs.

D. consolida is a hardy annual, of which many varieties are known as Rocket Larkspurs. It is found wild in sandy and chalky fields in Great Britain.

D. Barlowii is a magnificent double-flowered perennial hybrid; and the Bee-Larkspurs, consisting of *D. grandiflorum*, *D. Sibiricum*, *D. Chinense*, *D. mesoleucum*, and many more, are amongst the most showy plants of our gardens. These latter derive their name from a striking resemblance on the part of the petals to the black body of an humble-bee covered with yellow hairs; the head and legs of the insect being supposed to be immersed in the cup of the flower.

The only species that has been applied to any useful purpose is Stavesacre (*D. Staphisagria*), an annual inhabiting the warmer countries of the south of Europe. It has an upright branched stem about two feet high covered all over with close velvety down, and generally of a greenish purple colour. Its lower leaves are round, on long stalks, heart-shaped at the base, and divided into 5, 7, or 9 deep lobes of an oval or lanceolate figure; they are sharp-pointed, and either undivided or cut into a few lateral incisions; on the upper side they are deep green and almost smooth; on the under they are paler and velvety. The flowers are a dull grayish green, arranged in a lax spike at the extremity of the ramifications of the stem; their stalk is short and velvety, and has three linear short bracts. The sepals are green and velvety externally, with a short spur curved downwards. The four petals are separate from each other and smooth; the two upper are oval and rather long; the two lower have short stalks and a rounded, irregular, toothletted limb. The fruit is composed of three woolly capsules filled with grayish irregularly-triangular compressed very acrid bitter seeds. [STAPHISAGRIA, in ARTS AND SC. DIV.]

DELPHINORHYNCHUS. [CETACEA.]

DELPHINUS. [CETACEA.]

DELTHY'RIS. Dalman proposed this generic name as a substitute for the *Spirifera* of Sowerby, but few writers on fossil *Brachiopoda* have adopted it.

DELUNDUNG. [PRIONODON.]

DEMOISELLE. [GRUIDÆ.]

DENDRO'BIUM, an extensive genus of East Indian Epiphytical Plants, found in the whole of the damp tropical parts of Asia, and a little beyond the tropics in Japan and Australia, but unknown in the rest of the world. Above a hundred species are enumerated by systematic writers: *D. Pierardi*, *D. cucullatum*, *D. chrysanthum*, *D. aureum*, *D. fimbriatum*, *D. moschatum*, *D. densiflorum*, *D. pulchellum*, *D. nobile*, and a few more, are known in the collections of this country.

DENDROCITTA. [CORVIDÆ.]

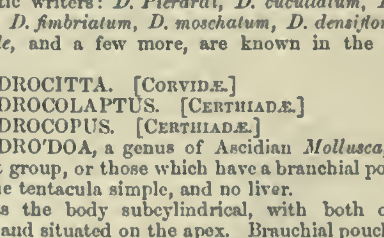
DENDROCOLAPTUS. [CERTHIADÆ.]

DENDROCOPUS. [CERTHIADÆ.]

DENDRO'DOA, a genus of Ascidian *Mollusca*, belonging to the aberrant group, or those which have a branchial pouch with only eight folds, the tentacula simple, and no liver.

It has the body subcylindrical, with both orifices exceedingly minute, and situated on the apex. Branchial pouch marked with only eight folds, and having the reticulation continuous. Orifices terminal. Tentacula simple. Liver none. Ovary unique, branched, situated beneath the mantle and the branchial pouch. (W. S. M'Leay.)

D. glandaria. Body subcylindrical, with a round summit. Envelope whitish, subpellucid, coriaceous, and smooth, having its base rough with agglutinated pebbles: internally it has a pearly lustre, and is thickest towards the base. Orifices so little prominent as to be scarcely perceptible without a lens; separate from each other, and opening with four indistinct rays. Mantle muscular, but of uniform substance. Tentacula about twenty-six, simple, subulate, alternately long and short. Anterior nervous tubercle with many spirals. Branchial cavity occupying the whole length of the animal. Pharynx situated at the bottom of the cavity of the body. Œsophagus descending, and turning short round near the cardia into a cylindrical horizontal stomach, which is striated internally, and occupies with the pylorus (which turns round and lies parallel to it) the whole of the bottom of the cavity. Intestine very long. Rectum ascending, almost vertical; terminated by an anus, margined.



Dendrodoa glandaria.

a, natural size, seen on the right side: the base encrusted with pebbles, has the appearance of the cup of an acorn; *b*, the same seen obliquely, so as to show the top, which is a little compressed, and exhibits four points: the two lowest and largest are false orifices; the two smallest (which are so small as to be almost invisible to the naked eye) are the real orifices, the highest being the anal, and the other the branchial orifice.

Ovary one, situated on the left side, between the branchial pouch and the tunic. It consists of a trifurcated cylindrical stem, having at the base on one side a forked branch, on the other a simple one, all of the same thickness. Mr. M'Leay remarks that the organs of digestion have great affinity in external structure and position to those of *Cynthia pantex* of Savigny, except that the stomach and intestine are horizontal, and the anus simply margined, and that, different as this species is in external appearance from all other *Ascidiæ*, internally it agrees with the *Pandeciæ* in almost every essential respect but the ovary. He observes that this singular animal completes the circle of the genus *Ascidia* in the most beautiful manner. It agrees with the first sub-genus, *Cynthia*, in the nature of its branchial reticulation and of its digestive apparatus; but *Cynthia* has two ovaries, the right one contained in the intestinal loop, and the left one coating the tunic. The first of these, or the right ovary, is the only one possessed by *Pandecia*, and the left is the only one possessed by *Dendrodoa*. Mr. M'Leay concludes by stating that the distinction between the aberrant groups of *Ascidia* depends thus upon the nature of their system of generation, as that which exists between the two normal groups depends on their system of respiration.

(*Anatomical Observations on the Natural Group of Tunicata*, &c., by W. S. M'Leay, ; *Linn. Trans.*, vol. xiv.)

DE'NDRODUS, a genus of Placoid Fishes, from the Old Red-Sandstone of Elgin, Moray, and Russia. Professor Owen has described five species, and Agassiz a sixth.

DE'NDROMUS, a genus of Animals belonging to the order *Rodentia*, established by Dr. A. Smith in his 'Contributions to the Natural History of South Africa,' with the following characters:—

$$\text{Incisors, } \frac{2}{2}; \text{ Molars, } \frac{3-3}{3-3} = 16.$$

The upper incisors with a longitudinal furrow on their anterior face; the lower long, slender, with the cutting edge cuneated.

The upper first molar with six tubercles in a double row, and two indistinct ones besides, of which one is at the anterior part of the crown of the tooth, the other near another tubercle of the internal series, behind the tarnsverse incisorial lamina; the second molar with two or three longitudinal incisorial laminæ by the external margin of the crown, in the middle of which lie three or four obtuse transverse tubercles disposed in a row; the third molar has two transverse incisorial laminæ with an interjacent furrow. Below, the first molar has six tubercles disposed in a double series; the second, four obtuse tubercles arranged in the same order; the third is very small, with some transverse laminæ and furrows intermingled. No canines. Rostrum acute. Lip slit. Ears oblong, rather naked, and internally, near the skull, with two transverse membranaceous valvules, of which the lower lies over the external auditory meatus. Tail elongated, annulated, with scattered hairs. Feet divided, ambulatory; the anterior with three toes, and a wart in lieu of hallux; the posterior five-toed: claws falcular.

D. Typus. Above, brown, passing to ferrugineous; beneath, reddish-white; whiskers long, partly black and partly white; upper lip white; ears without and within slightly covered with a fine short reddish-white fur; extremities the same; tail pointed, considerably longer than the body, and of a faint grayish-brown colour; along the centre of the back, particularly towards the tail, an indistinct black line. Length from point of nose to root of tail, 3½ inches: length of tail, 4½ inches.

It inhabits South Africa, where it is found upon the branches of trees, &c., in which situations it constructs its nest and brings forth its young. Dr. Smith observes that the position of this little animal among the family of mice is not well determined; but that perhaps its place is after the Mouse. ('Zool. Journ.,' vol iv. p. 438.)

DENDROMUS. [DUCKS.]

DENDRONESSA. [DUCKS.]

DE'NDROPHIS (Fitzinger), a genus of Serpents placed by Cuvier under the great genus *Coluber*, and stated by him to be the *Ahætulla* of Gray. The species of this genus have, like the *Dipsas* of Laurenti, a line of wider scales along the back, and narrower scales along the flanks, but their head is not larger than their body, which is very slender and elongated. Their muzzle is not elongated, and they are not venomous. They inhabit India and Africa.

DENDROPHYLLIA. [MADREPHYLLIÆA.]

DE'NDROPLEX, a genus of Birds established by Mr. Swainson, and placed by him in the family *Certhiadæ* (Creepers), and sub-family *Certhiana*, which have the tail graduated and rigid.

The bill is very straight. Wings moderate, rounded; third, fourth, and fifth quills longest.

Mr. Swainson observes that he knows not whether the type of this genus has been described, and states that the living bird has all the manner of a *Picus*. Except in its perfectly straight bill, he adds, it differs not from *Dendrocolaptes*. ('Zool. Journ.,' vol. iii. p. 354.)

DENTA'LIUM, a genus of Gasteropodous *Mollusca*, whose place in the animal series was first satisfactorily determined by M. Deshayes. Rondelet considered the *Dentalia* as marine shell-worms (vermisseaux de mer), though he noticed them as worthy of particular attention. Lister introduced them at the end of the Limpets (*Patellæ*). Lang followed in nearly the same steps, separating, after the *Patellæ*, a section wherein he arranged, together with the *Dentalia*, all the calcareous tubes of Annelides then known. Breyne placed his genus *Tubulus*, containing the *Dentalia*, &c., at the head of his Monothalamous Shells, the first of the two grand orders, the Monothalamous and the Polythalamous, into which he divided the Testaceans. In this position *Dentalium* was separated from the *Patellæ* by all the other univalve shells comprised in the *Cochlidia*, as well as by the Polythalamous series; in short, by the entire interval of the Univalve Testaceans; Breyne, as M. Deshayes observes, having probably considered the *Patellæ* as the passage from the univalves to the bivalves, for he places them immediately before the latter. Tournefort gave the *Patellæ* a position at the head of the univalve shells, and at the end, before the bivalves, he placed the *Dentalia*, *Entalia*, and the other marine testaceous tubes. D'Argenville, in his 'Zoomorphose,' appears to be the first who attempted to give any notion at all approaching to reality of the animal, the result of a note and drawing which had been sent to him from India. Though the materials were too incomplete to furnish secure data for fixing its position, they gave information which former authors had not enjoyed, and there was certainly enough to prevent D'Argenville from placing it in the heterogeneous third division of his system, denominated by him the Multivalves. Linnæus arranged it immediately after *Patella*, and before *Serpula*, stating the animal to be a *Terebella*, and the shell to be univalve, tubular, straight (recta), monothalamous, and pervious at each extremity. Bruguière gave it nearly the same position: but if both these zoologists were right in making *Dentalium* follow *Patella*, they were as far wrong in placing it by the side of *Serpula*, *Teredo*, *Sabella*, and above all, *Aspergillum*. Lamarck, in his 'Système des Animaux sans Vertèbres' (1801), arranged *Dentalium* with *Terebella*,

1, *Dendrophis Ahætulla*, one fourth of the natural size; 1 *a*, head; 1 *b*, disposition of the scales above and below the vent. (Iconog.)

and other genera analogous in appearance. In the 'Philosophie Zoologique' he separated the class of worms of the 'Système' into two other classes, and formed the Annelides, with the section of External Worms (Vers Extérieurs). He elevated, observes M. Deshayes, this division sufficiently in the series of *Invertebrata*, the presence of a heart and a circulation making it approximate to the Mollusks; whilst the Worms, very inferior in organisation, remained between the soft *Radiata* and the Insects. In this new class, adds M. Deshayes, we find the *Dentalia* in the same section with *Serpula*, *Spirorbis*, and *Siliquaria*. This arrangement was not altered in 'L'Extrait du Cours,' published in 1811. But, in the great work of the 'Animaux sans Vertèbres,' Lamarck, assisted by the labours of Savigny, and deceived moreover by the communications of M. Fleuriau de Bellevue, considered *Dentalium* as approximated to *Clymene*, and placed it in the family of Maldanians of M. Savigny. Systematic authors generally, not knowing more than Lamarck did, that knowledge being confined to the tube, followed Lamarck's opinion. Cuvier, in the first edition, placed it among the Annélides Tubicoles, between *Aspergillum* (*Penicillus*, Lam.) and *Siliquaria*. Savigny, in his 'Système des Annélides,' gave a summary description of the animal, but it was too incomplete to decide the question finally, though sufficient to overthrow the observations of M. Fleuriau de Bellevue. The *D. Entalis*, which was sent to Savigny by our countryman Leach, gave sufficient information to that celebrated zoologist to enable him to say that the animal had no trace of rings, that it had no hairs (soies) on the lateral parts of the body, that it was essentially muscular, and that it could no longer remain among the *Chætopods*.

D. Entalis was the species on which M. Deshayes made his observations; and in a very interesting and elaborate paper read before the Society of Natural History of Paris, on the 18th of March, 1825, he gave the facts which led him to the conclusion stated at the commencement of this article. The following is a summary of his description: but we must premise that M. Deshayes's specimens were forwarded to him in spirit, and were consequently a good deal contracted :—

Externally the animal is conical and elongated, like the shelly investing tube (dorsal surface corresponding with the convexity of the shell; ventral surface corresponding with the concavity); smooth and truncated obliquely at the anterior end, the centre of the truncation with a small pyramidal process, which is the extremity of the foot. The posterior parts are less muscular, and the termination is usually a funnel-shaped expansion, variously developed in different individuals; for in some it is firm and well developed, and in others it is scarcely perceptible. This expansion is separated from the rest of the body by a strongly-defined contraction. There is a muscular ring, broader on the ventral than on the dorsal surface, above this contraction, and by that ring the animal is attached to the shell, which on its inner surface presents, at about one-fifth of its length from the posterior extremity, a corresponding impression in the shape of a horse-shoe, the interrupted portion being on the concave side. On the dorsal surface a small elevation is perceptible, at about one-third of its length from the anterior end, indicating the place of the head. The whole extent below this is occupied by two muscles on each side, distinctly observable through the abdominal parietes. These muscles are symmetrical, flattened, and directed obliquely from the sides of the foot towards the dorsal surface and the posterior extremity of the animal, giving rise to and becoming commingled with the muscle of attachment. On the abdominal surface, likewise, there are on each side, at about one-third of its length from the anterior end, two symmetrical organs deeply jagged, and of a dark brown colour: these form the liver. Below this point, nearly the whole of the abdomen is visible through its transparent parietes filled by granulations contained in the very large ovary, and by the straight descending intestine which terminates at the expanded extremity in a mesial vent. The whole of the anterior part of the animal is invested by a fine membrane, which is fixed posteriorly to the origin of the foot, and is free in front, where its circumference is thickened. It is perforated in its centre, and M. Deshayes considers this to be the mantle. The thickened portion is produced by a circular sphincter, which, when contracted, wrinkles the skin, closely embraces in its opening the extremity of the foot, and thus cuts off any external communication. M. D'Orbigny, jun., who furnished a drawing of the living animal in an expanded state, makes the dilated lobes of the foot resemble a flower whose undulated and small corolla supports in its centre a pistil thickened towards the middle, and pointed at its free end.

On slitting the mantle down the middle of its dorsal surface, separating it from its insertion to the right and left, and turning it downwards and to the right, the foot, the head, and the branchiæ appear.

The foot is elongated, subcylindrical, slightly conical, and flattened from above downwards, fleshy throughout, and situated at the inferior and anterior part of the head, having its upper and under surfaces slightly grooved in the middle. The anterior extremity is largest, and its centre is occupied by a sort of conical nipple, broader at its base, being there partly covered by two small notched lateral lobes, the notches corresponding with the grooves of the foot. The posterior extremity has a bifurcated appearance, owing to the attachment there of the retractor muscles; its middle portion projects a little into the abdominal cavity, giving support to the stomach and the other principal viscera.

The head consists only of a mouth, and is situated superiorly at the hinder extremity of the foot. It is bell-shaped, and flattened from before backwards. Two black points on its sides might be mistaken for eyes, but these are the jaws situated within the mouth, and visible through the thin substance of which it is composed: they are spherical, horny, rough on their outer surface, cleft in the middle, and bearing a considerable resemblance to a small bivalve shell. There are two lips deeply cleft at the margin, or, more properly speaking, furnished each of them with three pairs of labial tentacles, those of the posterior lip, the middle pair especially, being much larger than

1. Shell of *Dentalium Entalis*, natural size. 2. Shell magnified, broken longitudinally, showing the animal in a contracted state; *a*, the posterior extremity prolonging itself into a small accidental tube. 3. Magnified, representing the animal at the moment of its advancing out of the shell; *a*, *b*, the foot, the lobes of which are developed in the form of a corolla; *c*, a part of the collar. 4. The animal magnified, abdominal aspect; *a*, extremity of the foot; *b*, the collar; *c*, *c*, the mantle; *d*, *d*, the liver; *e*, the intestine; *f*, the ovary; *g*, the muscle of insertion; *j*, *h*, the pavilion and its neck; *i*, the vent. 5. Magnified, dorsal aspect; *a*, extremity of the foot; *b*, the collar; *c*, *c*, the mantle; *d*, slight projection produced by the head and the branchiæ; *e*, *e*, internal retractile muscles; *f*, *f*, external retractile muscle; *g*, neck of the pavilion; *h*, the pavilion. 6. Magnified: the mantle has been slit in the dorsal and mesial line, detached in part from its posterior insertion, and turned aside showing, *a*, the extremity of the foot which closes the aperture *j*, of the collar *l*, *m*, of the mantle *n*, *o*, *p*; *b*, *b*, lobes of the foot; *c*, the foot itself, presenting a depression or channel running its whole length; *d*, the head; *e*, the cerebral ganglion; *f*, *f*, the two buccal jaws; *g*, *g*, the pedicles or branchiferous membranes; *h*, *h*, *i*, *i*, the branchiæ; *p*, *p*, *q*, *q*, the retractor muscles; *s*, the muscle of insertion; *t*, the neck of the pavilion. 7. fig. 4 natural size. 8. fig. 5 natural size. (Deshayes.)

those of the anterior. There is a naked space in the centre of the anterior lip indicating the aperture of the mouth, which is contracted into a short fleshy œsophagus, terminating rapidly in a thick pear-shaped stomach, supported by and closely adhering to the extremity of the foot, and containing within, near the cardiac opening, a rather complicated tooth-like apparatus. By a distinct vessel from each of the symmetrical lobes of the liver its secretion is poured into the stomach, which terminates below in a slender, transparent, straight, mesial intestine, opening, as before observed, at the dilated posterior extremity.

The heart is symmetrical, situated above the stomach, and contained in a pear-shaped pericardium. A vascular trunk issues from the anterior extremity of this sac, passes in the direction of the neck, and divides into two large branches, one being distributed to each of the branchiæ.

The branchiæ two, symmetrically situated on the lateral and posterior parts of the neck, and supported on a divided pedicle or branchiferous membrane, formed of many very fine soft flexible tentacular filaments with club-shaped terminations, and appearing from their position to be equally adapted for directing nourishment towards the mouth, and for fulfilling their important office of aerating the blood.

The nervous system is apparently ganglionic; the cerebral ganglion, the only one yet detected, is small, quadrilateral, considerably elongated, and placed longitudinally on the middle of the posterior surface of the head. Two very minute filaments issue from its inferior angles and pass to the œsophagus; they have not been traced beyond it.

M. de Blainville ('Malacologie,' 1825) agrees with M. Deshayes in the conclusion to which the latter came, namely, that *Dentalium* is a true Mollusk, and he makes it the type of his first order *Cirrhobranchiata*, of his first section of his third sub-class, *Paracephalophora Hermaphrodita*, placing it next to *Patella*. M. Rang (1829) follows De Blainville in referring it to his order *Cirrhobranchiata*, of which Rang makes it the only family, as does De Blainville, and he gives it a situation between *Fissurella* and *Patella*. Cuvier, in the last edition of the 'Règne Animal' (1830), still retains *Dentalium* among the Annélides, placing it immediately after *Siphostoma* of Otto; but he adds, that the recent observations of Savigny, and above all those of Deshayes, render such a classification very doubtful. The animal, he observes, does not appear to possess any sensible articulation, nor any lateral hairs (soies), but it has anteriorly (en avant) a membranous tube, in the interior of which is a sort of foot, or fleshy and conical operculum, which closes its orifice. On the base of this foot, he adds, is a small and flattened head, and on the nape are to be seen the plumose branchiæ. If, he continues, the operculum recals to mind the foot of the *Vermeti* and *Siliquariæ*, which have already been transferred to the class of mollusks, the branchiæ remind us of *Amphitrite* and *Terebellum*; and he concludes by remarking that ulterior observations on their anatomy, and principally on their nervous and vascular systems, will resolve this problem. Dr. J. E. Gray, who has compared the description of the animal given by M. Deshayes with specimens in the British Museum, is, he informs us, satisfied with the correctness of that description, and he considers that the most natural situation of *Dentalium* is nearest the *Fissurellæ*, but still far from them. The apices of the British species, he observes, often appear to be either broken off, or to have fallen off of themselves, like the tips of decollated shells; and he adds, that when the tip is broken, the animal forms a slight tube within, which is more or less produced beyond the tip; and that the late Dr. Turton described a specimen in this state as a species under the name of *D. labiatum*. Dr. Gray thinks that there is only one species found on our coasts, the other so-called species being mere varieties depending either on the worn or broken state of the specimens. In his 'Spicilegia Zoologica' he has described a *Siphunculus* which inhabits these shells, and which, he believes, has been considered by some authors to be the real inhabitant of the shell.

The geographical distribution of the genus is very much extended; few seas are without some of the species, which vary much in size. They are found sometimes in deep water, frequently near the shore. Professor E. Forbes has dredged the British species *D. Entalis* and *D. Tarentinum* at from ten to fifty fathoms' depth. About 30 recent species have been described, and 70 fossil.

M. Deshayes separates his species into four groups:—

1.

Shell not slit at its posterior extremity.

a. Longitudinal striæ.

Example, *D. Elephantinum.*

b. No longitudinal striæ.

Example, *D. Entalis.*

2.

Shell slit at its posterior extremity.

a. Longitudinal striæ.

Example, *D. striatum.*

b. No longitudinal striæ.

Example, *D. eburneum.*

3.

Shell having a marginal rim; not slit at its posterior extremity.

Example, *D. strangulatum.*

Fossil Dentalia.

"Of fossil species," says Mr. G. B. Sowerby, "there are many, particularly in the marine beds of the Tertiary Formations; the London Clay and the Calcaire Grossier swarm with several sorts not easily distinguishable from the recent species, among which we may particularly remark the fossil species from Piacenza, which so nearly resembles *D. Elephantinum* that Brocchi has not hesitated to refer it to that species, and the *D. eburneum* of Lamarck, which he says inhabits India, and is found fossil at Grignon. Deshayes in his 'Tables' gives the number of living species as 23, of the fossil (tertiary) 34, and the following, *D. Elephantinum, D. dentalis, D. novem costatum, D. Entalis, D. eburneum, D. fissura*, and *D. strangulatum*, as both living and fossil. Mr. Mantell in his tabular arrangement of the organic remains of the county of Sussex ('Geol. Trans.' vol. iii., second series, 1829), notes a species, which he does not name, in the blue clay of Bracklesham; *D. planum*, in the arenaceous limestone or sandstone of Bognor; *D. cylindricum*, in the sand on Emsworth Common; *D. striatum, D. ellipticum*, and *D. decussatum*, in the Gault, or Folkstone marl; and one or more, unnamed, in the Shanklin sand (Lower Greensand). Dr. Fitton figures one species, *D. medium*, from the Greensand of Blackdown, in his interesting 'Observations on some of the Strata between the Chalk and Oxford Oolite in the South-East of England.' ('Geol. Trans.' vol. iv., second series, 1836.) And he notes *D. ellipticum* in the Gault at Copt Point, on the authority of the Rev. G. E. Smith. In his 'Systematic and Stratigraphical List of Fossils' four named species, including *D. ellipticum, D. medium*, and an uncertain species, are noted from the Gault of Kent, South Wilts, and Cambridge, and the sands of Blackdown. Dr. Lea, in his 'Contributions to Geology' (1833), describes two new species, *D. alternatum* and *D. turritum*, from the Tertiary Beds of Claiborne, Alabama, and gives the following summary:—'In Great Britain 14 species have been obtained from the Lias to the Crag. M. Deshayes's 'Tables' give 34, of which 13 are from the Paris basin, the Eocene period. In this country (America) Dr. Morton has observed casts in the Upper Greensand of New Jersey and Delaware; and Mr. Say one species, the *D. attenuatum*, in the Tertiary of Maryland.'"

DENTA'RIA, a genus of Plants belonging to the natural order *Cruciferæ*, the sub-order *Siliquosæ*, and the tribe *Arabideæ*. It has a lanceolate compressed pod, flat nerveless valves, a capitate stigma; the seeds in a single row, the funiculus dilated, winged.

D. bulbifera, the Coralwort, is the only British species of this genus. It has a simple stem, alternate leaves, the lower leaves pinnate, the upper leaves simple, the axils of the leaves producing bulbs. It has a thick fleshy rhizoma with tooth-like knobs, hence its name. The flowers are rose-coloured or purple. It is a rare plant in England, but it is found in the neighbourhood of Tunbridge Wells.

(Babington, *Manual of British Botany.*)

DENTATI. [AMMONITES.]

DENTEX, a genus of Fishes belonging to the family *Sparidæ*. It has the following characters:—Body deep, compressed; dorsal fin single; head large; teeth conical, placed in a single row, four in the front above and below elongated, and curved inwards, forming hooks; teeth on the branchial arches, but none on the vomer or palatine bones; nose and suborbital space without scales; branchiostegous rays 6. There are several species of this genus.

D. vulgaris, the Four-Toothed Sparus, is regarded as a native of England. Only one specimen however seems to have been taken in this country, and that by Mr. Donovan in 1805 off Hastings. It is a very common fish in the Mediterranean, and is the *Dentex* of the Romans. It is remarkable for the great length of the four anterior teeth in each jaw. It acquires sometimes a large size weighing from 20 to 30 pounds, and measuring 3 feet in length. Mr. Donovan's specimen weighed 16 pounds. "A more voracious fish," says Mr. Donovan, "is scarcely known; and when we consider its ferocious inclination and the strength of its formidable canine teeth, we must be fully sensible of the great ability it possesses in attacking other fishes even of superior size, with advantage. It is asserted, that when taken in the fisherman's nets, it will seize upon the other fishes taken with it, and mangle them dreadfully. Being a swift swimmer it finds abundant prey, and soon attains to a considerable size. Willughby observes that small fishes of this species are rarely taken, and the same circumstance has been mentioned by later writers. During the winter it prefers deep waters, but in the spring or about May it quits this retreat, and approaches the entrance of great rivers, where it deposits its spawn between the crevices of stones and rocks.

"The fisheries for this kind of *Sparus* are carried on upon an extensive scale in the warmer parts of Europe. In the æstuaries of Dalmatia and the Levant, the capture of this fish is an object of material consideration, both to the inhabitants generally as a wholesome and palatable food when fresh, and to the mercantile interests of those countries as an article of commerce. They prepare the fish according to ancient custom, by cutting it in pieces and packing it in barrels with vinegar and spices, in which state it will keep perfectly well for twelve months."

(Yarrell, *British Fishes.*)

DENTIPORA. [MADREPOREA.]

DENTIROSTRES. [BIRDS.]

DENTITION, the formation and evolution of the teeth. The varied processes by which the teeth are formed, developed, and arranged are among the most curious and complicated operations of the animal economy. The different stages of dentition, in the human being, mark distinct epochs of human life, in which many important changes occur in the physical frame, simultaneously with which new mental powers are developed.

The teeth differ in their organisation in several important respects from all other organs of the body. They are of a bony structure, and are placed in the arches of the upper and lower maxillary or jaw-bones. They consist of two sets, of which the one is intended to last only for a short time, while the other is destined to last during the whole term of life. The first are called the temporary and the second the permanent teeth. The temporary teeth, 20 in number, are in general considerably smaller than the permanent, have a less firm and solid texture, and their characteristic forms and prominences are much less strongly marked. The permanent teeth, 32 in number, are arranged in perfect uniformity, 8 on each side of each jaw, those of the one side exactly corresponding with those of the opposite. They are divided into four distinct classes, which present specific differences in size, form, development, articulation, and use; namely, on each side of each jaw, two incisores, one cuspidatus, two bicuspides, and three molares.

For our knowledge of the early history of the development of the teeth we are principally indebted to Professor Goodsir of Edinburgh, who in 1839 published his views upon this subject. In giving an account of his researches and the additional facts that are known on this subject, we shall employ the lectures of Mr. Tomes on 'Dental Physiology,' as one of the most recent and complete works on the subject.

Preparation is made for the development of the teeth at a very early period of fœtal existence. At the sixth week of the existence of the human embryo, on examining the mouth, a groove is observed which is called the primitive dental groove, and in it the first germs of the teeth are observed. At the seventh week a slight projection of the mucous membrane at the bottom of this groove takes place, and which soon increases in size and forms a papilla. This papilla is the first condition of the tooth-pulp, and is composed of a mass of cells, each containing a nucleus, or cytoblast. No vessels are yet seen in the pulp, but they pass under it to the mucous membrane. As the papilla increases in size the vessels become elevated, and pass into its substance. The first papilla thus formed constitutes the follicle of the anterior temporary molar tooth, those of the upper jaw appearing before those of the lower. Subsequently the papillæ of the other teeth are developed, and by the tenth week we have in the dental grooves 20 papillæ corresponding to the 20 temporary teeth. As the papillæ grow the walls of the dental groove increase, and send out laminæ towards each other, which meeting, unite, and form septa. By these means the papillæ are inclosed in a series of cells or cavities with open mouths called follicles. The septa are all developed by the thirteenth week, leaving behind in the dental groove an open portion.

A change now comes on in the shape of the papillæ, which, instead of remaining as hitherto simple round blunt masses, become changed into special characteristic forms. The papillæ, from their more rapid growth, protrude also from the open mouths of the follicles. With this change in the shape of the papillæ a growth of lids or opercula to the open mouths of the follicles takes place. At the fourteenth week the inner lip of the dental groove has increased in size, and applies itself in a valvular manner to the outer lip. The relative growth of the papillæ and follicles is now reversed, the former beginning to sink by the increased growth of the latter. At this time also a secondary dental groove is observed, which is destined to furnish the papillæ of the permanent teeth. It gradually appears in the form of small crescent-shaped depressions immediately behind the inner opercula of each of the follicles of the first or milk series of papillæ. By the fourteenth or fifteenth week, through the adhesion of the opercula in the first groove, the follicles have become sacs, and the same change subsequently occurs in the secondary groove inclosing the permanent teeth. The space left open in the primitive dental groove at the end of the sixteenth or seventeenth week exhibits papillæ which represent the anterior permanent molar teeth.

From the time of the closure of the milk follicles the pulps gradually assume their peculiar shape, and those destined for the formation of the molar teeth are divided at the base for the growth of their several roots. With these progressive changes, the sac growing faster than the pulp, an intervening space is formed, in which is developed a soft granular substance, which for a time increases in quantity, and is adherent to the inner surface of the sac, but not to the pulp, though closely applied to the surface of the latter.

At this stage of their growth each sac receives a twig from the dental artery; but this does not penetrate the granular substance.

The next step in the general process of development is the appearance of caps of tooth-substance upon the tips of the pulps, and is accompanied by a diminution of the granular substance, which entirely disappears when the tooth-substance is perfectly developed. From the last-mentioned period up to the eighth month the cavities devoted to the ten anterior permanent teeth gradually recede from their position between the milk-sacs and the gums, and are now posterior to the milk-sacs. This separation of the sacs has led to the notion that the permanent sacs are formed from the temporary ones by a process of gemmiparous fission; but the observations of Professor Goodsir have demonstrated that this view is entirely erroneous.

At about the time of birth the fangs of the incisors begin to be formed. This process is attended with three separate actions:—1, elongation of the base of the pulp; 2, deposition of dentine upon it; 3, adhesion of the contiguous portion of the sac to the surface of this dentine.

The central incisors pass through the gum, or are cut as it is called, about the eighth or ninth month after birth. The crown of the tooth being perfected, and the formation of the fang advanced by the triplex action already described, an action is set up by which the edge of the tooth passes through the gum. Here then terminates the saccular stage of the tooth, the sac having been opened by the passage of the tooth through the gum. It must be borne in mind that with the development of dentine for the fang the sac becomes adherent to its surface, but not to the surface of the enamel. A probe might be passed down the surface of the enamel to the neck of the tooth so soon as the sac is opened by the edge of the tooth. When once the tooth is cut growth progresses rapidly. The tooth however appears to grow more rapidly than it really does, and from the following causes:—The sac being opened, and its inner surface thereby rendered continuous with that of the gum, a strong disposition to contract seems to come into force in that portion lying against the enamel, and as the gum constitutes one fixed point, and the adhesion of the sac to the neck of the tooth the other, the lower is as it were lifted out of the gum by the shrinking of the sac between these two points. As a consequence of this movement, the distance between the unfinished end of the fang and the fundus of the alveolus is lengthened. The socket now rapidly adapts itself to the neck of the tooth, to which it becomes accurately moulded. The pulp elongates itself and diminishes at its base, till at the completion of a tooth it has diminished to the size of a thread and is constituted principally of the dental vessels and nerves. As the temporary teeth have advanced towards the surface, the sacs for the permanent teeth have receded behind them, and have become inclosed in proper bony crypts, from each of which a foramen proceeds. In the sacs for the front teeth these foramina open immediately posterior to the milk teeth, but those for the bicuspids open into the alveoli of the milk molars. From the apex of each sac a fibrous cord proceeds through the foramen to join the gum near the neck of the corresponding milk tooth, excepting in those under the milk molars, in which the fibrous cord unites with the periosteal lining of the temporary alveolus. These cords, or gubernacula as they are called, are formed of the obliterated portion of the pulp follicle, which it will be remembered was rendered external to the sac by the development and subsequent closure of the opercula. It seems the union of the two sides is sometimes incomplete, so that the cord is in fact a tube closed at its two extremities. The gubernaculum lengthens as the sac recedes from the surface, and disappears only after the tooth passes through the gum. From observing the position and the disappearance of the gubernaculum many have supposed that it leads or directs the developing tooth to its proper situation in the alveolar arch. Professor Goodsir, when speaking of the use of the cords and foramina, says:—

"The cords of communication which pass through these foramina are not tubular, although in some instances a portion of the unobliterated intra-follicular compartment of the original little cavity of reserve may be detected in them; they are merely those portions of the gum which originally contained the lines of adhesion of the depressions for the permanent teeth in the secondary dental groove, and which have been subsequently lengthened out in consequence of the necessarily retired position in which the permanent teeth have been developed during the active service of the temporary set.

"The cords and foramina are obliterated in the child, either because the former are to become useful as 'gubernacula,' and the latter as 'itinera dentium,' or, much more probably, in virtue of a law which appears to be a general one in the development of animal bodies, namely, that parts or organs which have once acted an important part, however atrophied they may afterwards become, yet never altogether disappear so long as they do not interfere with other parts or functions."

The sacs of the permanent teeth are supplied with blood-vessels first from the gums but afterwards from the milk-sacs. As the sacs sink deep into the alveolus they receive vessels from the proper dental canals.

Mr. Goodsir divides dentition into three stages: "First, the follicular, in which stage is included the papillæ when it existed as a simple prominence from the mucous membrane, and extends to the closure of the opercula. Secondly, the saccular, which commences with the closure of the opercula, and ends with the passage of the tooth through the gum. Thirdly, the eruptive, which commences when the tooth appears through the gum, and extends to the period when the permanent teeth are fully developed. These three stages, when considered in reference to any particular tooth, are well defined, but when viewed in reference to the whole set, or two sets, they are intermingled; thus, when one tooth-germ is in the saccular, another is in the follicular stage; again, when the temporary teeth are in the eruptive, the permanent teeth are in the saccular condition."

For an account of the development of the tissues which form the tooth, we must refer our readers to the article TEETH, in which the tissues themselves are described.

The age at which the teeth first make their appearance varies considerably, frequently without any apparent reference to the constitutional powers of the child. Instances are not wanting in which children have been born with two or more teeth. In many other cases the teeth have not come through the gum until fourteen or sixteen months, or even as late as two or three years. In general, however, dentition may be said to commence at the age of from five to eight months. The following table from Mr. Tomes's Lectures gives the result of the observations of several writers on this subject:—

Authors.	Central Incisors.	Lateral Incisors.	Canines.	1st Molar.	2d Molar
	Months.	Months.	Months.	Months.	Months.
Fox	6, 7, 8; extreme cases 4 to 13	7, 8, or 9	17 to 18	14 to 16	24 to 30
Hunter	7, 8, or 9	7, 8, or 9	20 to 24	20 to 24	20 to 24
Bell	5 to 8	7 to 10	14 to 20	12 to 16	18 to 36
Dr. Ashburner	7th, lower jaw; 8th, upper jaw	9th, upper jaw; 10th, lower jaw	16, 17, 18, 19 or 20	12 to 14	22 to 30

These periods are however only given as a general rule, liable to continual exceptions, not only in the time at which the different teeth appear, but also in the relative order of their precedence.

According to Dr. Ashburner, who has paid great attention to this subject, and who has had ample opportunities of observation, the teeth of the first dentition commonly cut in couples; the two anterior incisors of the lower jaw appear first; then, in perhaps from fifteen to twenty days the two anterior incisors of the upper jaw come through; to these succeed the lateral couple of incisors of the lower jaw; then come those of the upper jaw. After these the two molar teeth nearest to the lateral incisors of the lower jaw appear; then the first molars of the upper jaw; after which come the lower two canine; then the upper canine; then the two second molar of the lower jaw; and afterwards the corresponding molar of the upper jaw. The period occupied in the process is about two years from the appearance of the first tooth.

The first formed of the permanent teeth are the anterior molars, on which the first point of ossification may be seen at birth. At about the age of twelve months the ossification on these teeth has proceeded to a considerable extent; also on the permanent incisors, and it has commenced on the lower cuspidati, the upper ones being generally two or three months later. About the time when all the temporary teeth have made their appearance, ossification is found on the points of the bicuspids, and the bony shells of the teeth before mentioned have acquired considerable size.

Most of the permanent teeth are larger than those which precede them. They are placed during their progress a little behind them; hence they are confined within the segment of a smaller circle; consequently, as they approach more and more nearly to their ultimate size, they must become very much crowded in the jaw. "The examination of the maxillary bone of a child of about five years old," observes Mr. Bell, "will show this fact in a very striking manner. At this period the jaws being considerably deepened by the development of the alveolar processes, the sockets in which the permanent teeth are lodged will be found placed beneath those of the temporary, some higher than others, and the bony shells are closely packed in such a manner as to occupy the least possible space. Thus, in the upper jaw, the central incisors are situated immediately beneath the nose, the lateral incisors thrown back behind the points of the cuspidati, and the bases of the latter scarcely a quarter of an inch below the orbit; in the lower jaw the cuspidati are placed at the very base of the bone, with only a thin layer beneath them; but the crowding is much less considerable than in the upper jaw, from the smaller comparative size of the incisors.

"At from six to seven years of age the whole of the permanent teeth are more or less ossified, excepting the dentes sapientiæ; so that, previously to the shedding of any of the temporary teeth, there are at this time no less than forty-eight teeth in the two jaws; namely, twenty deciduous, the whole of which are perfected, and twenty-eight permanent, in different degrees of development, within the bones."

At a particular epoch of human life, the temporary teeth are exchanged for a more numerous set, of a stronger and more durable structure, and of increased power of mastication. The original teeth become loose in their sockets, their roots are eaten away, their crown crumbles and recedes from the gums, and at last they fall out. This change takes place in the temporary teeth exactly in the order in which they were originally formed, and in which they cut through the gums. Thus, the central incisors of the lower jaw fall away first, then those of the upper jaw, then go the interior lateral incisors, and so on.

The mode in which this change is effected, which constitutes the shedding of the teeth, is by a process of absorption. The anterior parietes of the cavities in which the permanent teeth are contained are removed by the absorbent vessels, in consequence of which the teeth are allowed to advance; next the sockets, then the roots, and lastly the crowns of the temporary teeth are absorbed. This absorption cannot be solely the effect of pressure produced by the advancing permanent teeth, for the process goes on when such pressure cannot possibly have existed; it is, in part at least, like the preparation of the cell for the reception of the permanent pulp, a true process of anticipation. Neither do the advancing permanent teeth displace the receding deciduous teeth; but the jaw grows and enlarges consentaneously with the increasing bulk and number of the teeth which it is destined to receive.

The change of the temporary for the permanent teeth commences, in the majority of instances, at about seven years of age; "though," says Mr. Bell, "I have occasionally known it to occur as early as five and as late as eight years and a half." The first permanent molars usually pierce the gum before the loss of the temporary central incisors, and their appearance may be considered as indicative of the approaching change. The following are about the medium periods at which the different permanent teeth are generally cut, but so irregular are they in this respect that comparatively little dependence can be placed on such a statement. Those of the lower are here indicated, and they most commonly precede the upper by about two or three months:—

Anterior Molars	6½ years
Central Incisors	7 "
Lateral Incisors	8 "
Anterior Bicuspids	9 "
Posterior Bicuspids	10 "
Cuspidati	11-12 "
Second Molars	12-13 "
Third Molars, or Dentes Sapientiæ	17-19 "

It has been supposed that the permanent teeth are subject to much irregularity in the time of their appearance. This however is an error, as within a limited period the appearance of the teeth in healthy children is very constant. The following extract from Mr. Saunders's work on 'The Teeth a Test of Age,' will be found to confirm this:—

"Thus, then, it appears that of 708 children of nine years old, 389 would have been pronounced on an application of this test to be near the completion of their ninth year; that is, they presented the full development of that age. But on the principle already stated—that of reckoning the fourth tooth as present when the three are fully developed—a still larger majority will be obtained, and instead of 389 the proportion will be as follows: of 708 children no less a number than 530 will be fully nine years of age. What, then, are the deviations in the remaining 178? They are the following: 126 would be pronounced eight years and six months, and the remaining 52 eight years of age; so that the extreme deviations are only twelve months, and these only in the inconsiderable proportion (when compared with the results obtained by other criteria) of 52 in 708.

"Again, of 338 children under thirteen years of age, no less than 294 might have been pronounced with confidence to be of that age. The remaining 44 would have been considered as follows: 36 in their thirteenth and 8 near the completion of their twelfth year."

Such are the main phenomena which relate to the process of dentition when this operation is performed in a perfectly natural and healthy manner. But this process is exceedingly apt to become deranged, producing evils in the system often most serious, and even fatal; and the preceding account of the natural process will enable us readily to understand the nature, extent, and causes of the diseases which so often result from the morbid progress of the function. [DENTITION DISEASES, in ARTS AND SC. DIV.]

(Bell, *On the Anatomy, Physiology, and Diseases of the Teeth*; Ashburner, *On Dentition and some co-incident Disorders*; Meckel, *Man. d'Anat.*; Serres, *Nouvelle Théorie de la Dentition*; De la Barre, *Seconde Dentition*; Owen, *Odontography*; Goodsir, *On the Teeth*; *Edinburgh Med. and Surg. Journal*, vol. li.; Tomes, *On the Structure of the Teeth*; *Proc. Roy. Soc.*, 1838; Tomes, *Lectures on Dental Physiology and Surgery*; Huxley, *On the Development of the Teeth*, in *Quarterly Microscopical Journal*, vol. i.)

DEODARA. [ABIES.]

DERBYSHIRE SPAR. [FLUOR-SPAR.]

DERCÆA. [STENELYTRA.]

DERMATINE, a Mineral found in the serpentine quarry near Waldheim. It occurs in reniform masses, rarely globular, and in thin coatings or crusts. Its colour is dark olive-green or liver-brown. Streak yellow inclining to gray. The fracture is conchoidal. It feels greasy, but does not adhere to the tongue. Its hardness is about 2·0. Lustre somewhat resinous. Specific gravity, 2·136. The following analysis is by Ficinus:—

Silica	35·800
Magnesia	23·700
Protoxide of Iron	11·333
Protoxide of Manganese	2·250
Alumina	0·416
Lime	0·833
Water and Carbonic Acid	25·200

DERMATOBRANCHUS, a genus of Molluscous Animals established by M. Van-Hasselt, and arranged by him among the *Nudibranchiata.* It has the following characters:—Animal depressed, semicircular, provided with a considerably large foot, and protected above by an enlarged mantle, rounded anteriorly, narrowed posteriorly, beset with elongated striæ or pustules, which are branchial. A pair of short, approximated, contractile tentacula situated between the head and the mantle. Eyes none (?). Three apertures on the right side of the body, the anterior opening near the head for the generative apparatus, the second for the vent, and the third for the urinary organ. It is an inhabitant of the coast of Java.

DERMESTES. [DERMESTIDÆ.]

DERME'STIDÆ, Leach (from Δερμήστης, a moth or worm that eats skins), a family of Animals belonging to the order of Coleopterous Insects of the section *Necrophaga* (M'Leay). They have the following characters:—Antennæ short, 11-jointed, terminated by a compressed club, consisting of 3 or 4 joints; palpi small; mandibles short, thick, and generally dentated; head deeply inserted into the thorax; body generally oval, and more or less furnished with scales or hairs; legs short; tarsi 5-jointed. The species of this family are for the most part of small size: their larvæ (at least those which are known) are covered with hair, and feed upon animal substances. It includes the genera *Dermestes, Ctesias, Megatoma, Attagenus, Aspidiphorus, Nogoderma, Anthrenus, Globulicome, Limnichus*, and *Trogoderma*. The species of many of these genera whilst in a larva state do great mischief in houses. They are especially destructive to the collections of the naturalist. The perfect insects are harmless, living on flowers. They are found throughout Europe, Australia, Africa, and America.

The distinguishing characters of the genus *Dermestes* are:—Antennæ scarcely differing in the sexes; the basal joint thick, the six following joints nearly of equal size, the eighth broader than long, the ninth and tenth very broad and nearly of equal size, the eleventh also broad but not equal in size to the two preceding; palpi short and thick; body of an elongated oval shape.

D. lardarius is about a quarter of an inch in length and of a dull black colour; the basal half of each elytron is of an ashy tint, and has three black spots.

This insect is sometimes very abundant in houses in the neighbourhood of London and elsewhere, and when this is the case is very destructive, since it will devour almost any animal substance, but we believe only in a dried state.

D. vulpinus is about the same size as the last, from which it may be distinguished by the elytra being totally black, and the sides of the thorax and under parts of the body being covered with white scales.

This insect is brought over in great abundance in ships laden with hides. We have seen them in skins of quadrupeds both from India and America. The larva is about half an inch in length, and covered with blackish-brown hairs. Like the perfect insect it feeds upon dried skins, and hence when abundant is very destructive to this sort of property. In the 14th vol. of the 'Linnean Transactions' is a notice of the occurrence of several specimens of this insect, and also of another beetle (*Necrobia violacea*) in the Egyptian mummy; and in the 'Transactions of the Entomological Society,' vol. i., the Rev. F. W. Hope describes several species of Coleopterous Insects which had been found in the heads of Egyptian mummies. They are as follows:—*Necrobia Mumiarium, D. pollinctus, D. Roei*, and *D. elongatus*. Accompanying these insects there were also found some fragments of a species of *Pimelia*—probably the *P. spinulosa*.

D. murinus is also about a quarter of an inch in length, and of a black colour; the upper parts of the head, thorax, and elytra, are mottled with scales of an ashy tint; the scutellum is of a fulvous colour; the under parts of the body are white.

The species is common in various parts of England, and is found in dried animals which have been suspended in the open air by gamekeepers and other persons.

In the genus *Ctesias* (Stephens) the two basal joints of the antennæ are thick; the six following are nearly of equal size and rather slender; the ninth joint is rather long and of an obconic form; the tenth joint is shorter than the last; and the terminal joint is conical. These three joints form together an elongated knob.

C. Serra is about an eighth of an inch in length, of a black colour, with yellowish antennæ. It is found under the loose bark of elm-trees. The larva is covered with long hairs.

Megatoma (Herbst).—In this genus the two basal joints of the antennæ are thick; the four following are slender; the seventh and eighth joints are larger than the last-mentioned, and the remainder form an elongated club; the terminal joint is twice as long as the others in the male, and but slightly elongated in the female.

Attagenus (Latreille).—Antennæ with the basal joint thick; the second less robust and shorter; the three following joints slender; the sixth, seventh, and eighth joints gradually increasing in size; the remainder forming a 3-jointed club, of which the terminal joint is extremely long and almost cylindrical in the male, and of an elongated oval form in the female.

A. Pellio is about an eighth of an inch in length, and of a black colour; the base of the antennæ is yellowish, and there is a round white spot in the middle of each elytron.

This insect is common in houses, and is very frequently found in quills, upon the pith of which it probably feeds.

DERMO'CHELYS. [CHELONIA.]

DERRIAS. [BABOON.]

DESMAUS. [SORECIDÆ.]

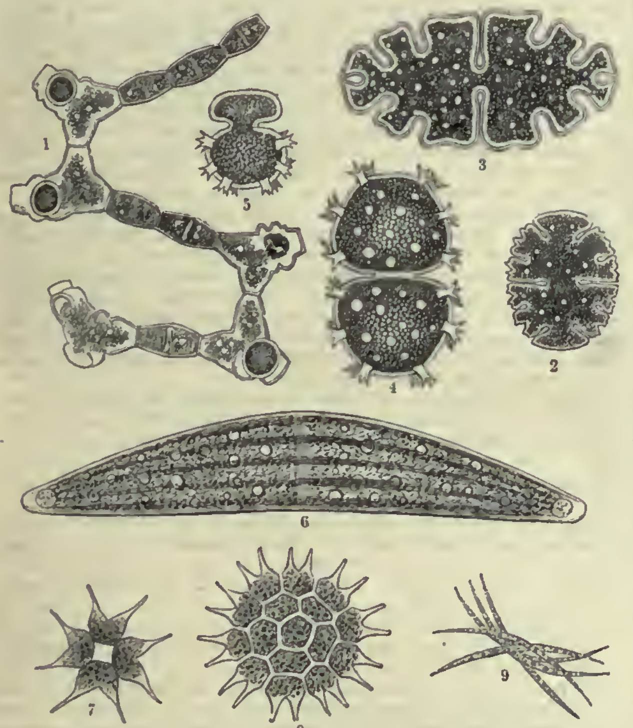
DESMIDIEÆ, a group of organised beings regarded by some naturalists as Animals and by others as Plants. The botanists who have adopted them into the vegetable kingdom have regarded them as *Algæ*, and allied to the *Diatomaceæ*. Some however who admit the vegetable characters of *Desmidieæ* deny them to *Diatomaceæ*. Dr. Lindley admits the *Desmidieæ* as a sub-order of the *Diatomaceæ*, which he characterises as crystalline angular fragmentary bodies, brittle, and multiplying by spontaneous separation. Amongst this group of beings the *Desmidieæ* are characterised as being 'cylindrical.' The following is the definition of this family as given by Mr. Ralfs in his 'British Desmidieæ,' a work which has greatly increased our knowledge of these obscure beings:—"Freshwater figured, mucous, and microscopic *Algæ*, of a green colour. Transverse division mostly complete, but in some genera incomplete. Cells or joints of two symmetrical valves, the junction always marked by the division of the endochrome, often also by a constriction. Sporangia formed by the coupling of the cells and union of their contents." It will be seen from this definition that Mr. Ralfs regards these beings as plants. The principal points on which he relies for establishing this position are the occurrence of conjugation and swarming, and the presence of starch amongst the *Desmidieæ*.

The occurrence of a union or conjugation of the two filaments for the production of spores, has long been known amongst certain forms of *Confervæ*. This has been seen by many observers to occur amongst the *Desmidieæ*. In the *Euastrum rupestre* (*fig.* 3 represents the genus) Nägeli describes this process. Two individuals are placed close together, and push out short processes, which meet, and by the absorption of the wall constitute a canal, into which the entire contents of the two cells thus connected enter, and combine together to form one mass which constitutes a single cell. This process is not always identical in different species. In *Closterium* (*fig.* 6) the middle of the cell-membrane dehisces with a transverse fissure, and the entire contents from two contiguous opened cells coalesce into a single round or angular mass. Siebold says, with regard to the spores or green bodies which result from the union of the cells, that they are not in all cases developed into a single *Closterium*, like spores; but that, as in the case of other *Algæ*, such as *Vaucheria* and *Œdogonium*, there are two sorts of spore-formations, and that under certain circumstances these green bodies represent a germ, capsule, or sporangium, in which, by a process of division, several young *Closteria* come to be perfected. The union of the cells of *Didymoprium Borreri* is seen in *fig.* 1.

The process above described appears to be one entirely confined to the vegetable kingdom, as it has never been observed amongst unicellular organisms, which are regarded as decidedly animal.

The process of swarming is one which, although a few years ago its distinguishing feature would have been regarded as entitling the organism exhibiting it to a place in the animal kingdom, is by Mr. Ralfs and other English naturalists regarded as purely vegetable. It has been observed in many species of *Confervaceæ*, more especially in *Achlya prolifera* [ACHLYA] and *Conferva ærea*. The following is M. Agardh's account of this curious phenomenon in the latter plant. After describing the green matter in the joints, he says:—"The granules of which it is composed detach themselves from the mass one after another, and having thus become free they move about in the vacant space of the joint with an extreme rapidity. At the same time the exterior membrane of the joint is observed to swell in one point till it there forms a little mamilla, which is to become the point from which the moving granules finally issue. By the extension of the membrane for the formation of the mamilla, the tender fibres of which it is composed separating, cause an opening at the end of the mamilla, and it is by this passage that the granules escape. At first they issue in a body, but soon those which remain, swimming in a much larger space, have much more difficulty in escaping; and it is only after innumerable knockings (titubations) against the walls of their prison that they succeed in finding an exit. From the first instant of the motion, one observes that the granules or sporules are furnished with a little beak, a kind of anterior process always distinguishable from the body of the sporule by its paler colour. It is on the vibrations of this beak that the motion, as I conceive, depends; at least I have never been able to discover any cilia. However I will not venture to deny the existence of these; for with a very high power of a compound microscope one sees the granules surrounded with a hyaline border, as we find among the ciliated *Infusoria* on applying a glass of insufficient power. The sporules during their motion always present this beak in front of their body, as if it served to show them the way; but when they cease to move, by bending it back along the side of their body, they resume the spherical form; so that before and after the motion one sees no trace of this beak. The motion of the sporules before their exit from this point consists principally in quick dartings along the walls of the articulation, knocking themselves against them by innumerable shocks; and in some cases we are almost forced to believe that it is by this motion of the sporules that the mamilla is formed. Escaped from their prison, they continue their motion for one or two hours; and retiring always towards the darker edge of the vessel, sometimes they prolong their wandering courses, sometimes they remain in the same place, causing their beak to vibrate in rapid circles. Finally they collect in dense masses, containing innumerable grains, and attach themselves to some extraneous body at the bottom or on the surface of the water, where they hasten to develop filaments like those of the mother plant." This process, to which the name swarming has been given, has been observed by Mr. Ralfs, Dr. Hassall, and others in various species of *Desmidieæ*, more especially in *Sphæroplea crispa* and *Draparnauldia tenuis*. No similar movements to these have been anywhere observed amongst the ova of the animal kingdom.

The presence of starch in the *Desmidieæ* is a third point relied on by Mr. Ralfs as distinguishing the vegetable kingdom. The existence of this substance is easily ascertained by the well-known reaction of iodine upon it. Meyen first discovered this substance in the *Algæ*, and Mr. Ralfs and others have confirmed the correctness of his observations. At the same time it should be stated that starch, although not found present in the tissues of the lower animals, has recently been detected in the brain of man by Mr. Busk ('Microscopical Journal,' vol. ii. p. 105). This may lead to the discovery of the existence of this substance more generally in the animal kingdom than has been hitherto supposed.



1. *Didymoprium Borreri*, with the cells uniting to form the green matter. 2. *Micrasterias crenata*. 3. *Euastrum oblongum*. 4. *Xanthidium armatum*. 5. The same with a frond acquiring a new segment by division. 6. *Closterium Lunula*. 7. *Pediastrum simplex*. 8. *Pediastrum Boryanum*. 9. *Ankistrodesmus falcatus*.

The following reasons are given by Mr. Dalrymple, after giving an account of the structure of *Closteria*, for placing the species of this genus amongst animals :—

1st. That while *Closterium* has a circulation of molecules greatly resembling that of plants, it has also a definite organ unknown in the vegetable world, in which the active molecules appear to enjoy an independent motion, and the parietes of which appear capable of contracting upon its contents.

2nd. That the green gelatinous body is contained in a membranous envelope, which, while it is elastic, contracts also upon the action of certain reagents, whose effects cannot be considered purely chemical.

3rd. The comparison of the supposed ova with cytoblasts and cells of plants precludes the possibility of our considering them as the latter, while the appearance of a vitelline nucleus, transparent but molecular fluid, a chorion, or shell, determines them as animal ova. It was shown to be impossible that these eggs had been deposited in the empty shell by other *Infusoria*, or that they were the produce of some Entozoon.

4th. That while it was impossible to determine whether the vague motions of *Closterium* were voluntary or not, yet the idea the author had formed of a suctorial apparatus forbade his classing them with plants.

On these reasons, Mr. Ralfs remarks, that the peculiar organ—the terminal globules—of the *Closteria* are as much vegetable as animal. That the throwing off the contents of the cell through chemical reagents, is as much vegetable as animal. "If fresh water touches *Griffithsia setacea*, the joints burst and spirt out their contents." That the supposed ova contain starch, and are therefore vegetable. That he cannot discover that the orifices at the extremities of some of the *Desmidieæ* are tubes, or that they possess a suctorial power.

The *Desmidieæ* are all of an herbaceous green colour, and from this circumstance are easily discovered amongst the other microscopic beings with which they occur. They are mostly inhabitants of fresh water. Mr. Thwaites records two or three species from brackish water. They are remarkable for the very definite outline which their forms assume, especially in the genera *Micrasterias* (*fig.* 2), *Euastrum* (*fig.* 3), *Xanthidium* (*fig.* 4), and *Pediastrum* (*figs.* 7, 8). Their most obvious characteristic however is their evident division into two valves or segments. The point of union between the two segments is in general very definitely marked. In *Pediastrum* and *Scenedesmus* it is less obvious than other genera. It is at this point of union that the cell opens and discharges its contents. "An uninterrupted gradation," says Mr. Ralfs, "may be traced from species in which these characters are inconspicuous to those in which they are fully developed: thus in *Closterium* and some species of *Penium* there is no constriction; in *Tetmemorus*, in some *Cosmaria*, and in *Hyalotheca*, it is quite evident, although still but slight; in *Didymoprium* and *Desmidium* it is denoted by a notch at each angle; but in *Sphærozosma*, *Micrasterias* (*fig.* 2), and some other genera, the constriction is very deep, and the connecting portion forms a new cord between the segments, which appear like distinct cells, and are so considered by Ehrenberg and others." He further adds, "That the frond in *Euastrum* (*fig.* 3) and allied genera is really a constricted cell, and not a binate one, will, I am persuaded, be apparent to any one who traces the gradations mentioned above."

The manner in which the cells of the *Desmidieæ* are multiplied, is by means of repeated transverse divisions. This process may be seen in *Euastrum*, the new segments appearing at the constricted part of the original segments. At first the new segments appear as two roundish hyaline bodies formed of the substance of the connecting tube. These lobules increase in size, acquire colour, and gradually put on the appearance of the old portions. As they increase in size the original segments are pushed away from each other, and at length an entire separation takes place, each old segment taking with it a new segment to supply the place of the old one. This process is seen going on in *fig.* 5. This process is repeated again and again, so that the older segments are united successively, as it were, with many generations. This multiplication however has its limits, for the time comes when the segments gradually enlarge whilst they divide, and at length the plant ceases to grow. When this occurs no more segments are produced, the internal matter changes its appearance, increases in density, and contains starch-granules. The spore is now formed, which is to give birth to a new individual, and the old one perishes. The separate cells formed by this process of segmentation must be regarded as continuations of the same individual. They are like the grafts and buds from a tree; they continue the individual.

The reproduction of the *Desmidieæ* seems to take place in two ways: first, by the formation of granular contents in the cell, which have the power of moving, burst the cell, and produce the phenomena of swarming above referred to; and secondly, by the formation of a sporangium, or case containing spores, after the union or conjugation of the cells before described. The sporangia assume a variety of forms, and are sometimes covered with spines, and Mr. Ralfs says, "That the orbicular spinous bodies so frequent in flint are fossil sporangia of *Desmidieæ*, cannot, I think, be doubtful, when they are compared with figures of recent ones."

Movements of the cell-contents of *Desmidieæ*, similar to the cyclosis of higher plants, have been observed by Dalrymple, Bailey, and others. These movements consist of definite currents of the cell-contents, passing in two opposite directions, the one along the side of the cell, and the other along the periphery of the gelatinous mass in their interior. Labarzewski, a German observer, states that these currents are intermittent, lasting each time for about seven seconds.

The part fulfilled by the *Desmidieæ* in creation is little known. They undoubtedly purify the water in which they live in the same manner as other plants, and furnish food to a number of fresh-water animals. As they do not attach themselves to external objects they are seldom found living in running streams. They are sometimes found in the beds of large rivers, and several species are enumerated by Drs. Lankester and Redfern, in their report on the 'Microscopical Characters of the Water of the Thames.' The best places for procuring them are small shallow pools which do not dry up in the summer. Mr. Ralfs says, however, that the same species never occur in the same pools two years in succession. They prefer open moors and exposed places, and are rarely found in woods, shady places, or deep ditches. They are seldom found in turbid water of any kind. In this respect they are the opposite of their congeners the *Diatomaceæ*, which almost as a rule are found where the *Desmidieæ* are not.

The best way of procuring them for examination is to take a piece of linen, lay it on the ground in the form of a bag, and then, by the aid of a tin box or ladle, scoop up the water, and strain it through the bag. After this process has been repeated a few times, the specimens of *Desmidieæ* will be found in great abundance on the linen, which, if kept moist, will allow of the growth and development of these beautiful objects for many months.

The study of this family will undoubtedly amply repay the naturalist for years to come. Comparatively little is known of the species beyond the continent of Europe. The following is an analysis of the genera found by Mr. Ralfs in the British Islands :—

*

Plant an elongated jointed filament. Sporangia orbicular, smooth.

1. *Hyalotheca.*—Filament cylindrical. Two species.
2. *Didymoprium.*—Filament cylindrical, or sub-cylindrical. Joints with two opposite or dentate projections. (*Fig.* 1.) Two species.
3. *Desmidium.*—Filament triangular, or quadrangular; joints connected by a thickened border. Two species.
4. *Aptogonum.*—Filament triangular or plane, with foramina between the joints. One species.
5. *Sphærozosma.*—Filament plane, margins incised or sinuated; joints with junction-glands. Two species.

**

Frond simple from complete transverse division, distinctly constricted at the junction of the segments, which are seldom longer than broad; sporangia spinous or tuberculated, rarely if ever smooth.

6. *Micrasterias.*—Lobes of the segments incised or bidentate. (*Fig.* 2.) Thirteen species.
7. *Euastrum.*—Segments sinuated, generally notched at the end, and with inflated protuberances. (*Fig.* 3.) Eighteen species.
8. *Cosmarium.*—Segments in front view neither notched nor sinuated; in end view elliptic, circular, or cruciform. Thirty-three species.
9. *Xanthidium.*—Segments compressed, entire, and spinous. (*Figs.* 4 and 5.) Six species.
10. *Arthrodesmus.*—Segments compressed, and having only two spines or mucros. Two species.
11. *Staurastrum.*—End view angular, radiate, or with elongated processes which are never geminate. Forty species.
12. *Didymocladon.*—Segments angular, each angle having two processes, one inferior and parallel with the similar one of the other segment, the other superior and divergent. One species.

***

Frond simple, from complete transverse division, generally much elongated, never spinous, frequently not constricted at the centre. Sporangia smooth.

13. *Tetmemorus.*—Frond straight, constricted at the centre, and notched at the ends. Three species.
14. *Penium.*—Frond straight, scarcely constricted at the centre. Eight species.
15. *Docidium.*—Frond straight, much elongated, constricted at the centre, truncate at the ends. Seven species.
16. *Closterium.*—Frond crescent-shaped or arcuate, not constricted at the centre. (*Fig.* 6.) Twenty-two species.
17. *Spirotænia.*—Frond straight, not constricted at the centre; endochrome spirally twisted. Two species.

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Cells elongated, entire, fasciculated.

18. *Ankistrodesmus.* Cells aggregated into faggot-like bundles. (*Fig.* 9). One species.

*****

Frond composed of few cells, definite in number, and not forming a filament. (Sporangia unknown).

19. *Pediastrum.*—Cells arranged in the form of a flattened star, their outer margin bidentate. (*Figs.* 7 & 8.) Eleven species.
20. *Scenedesmus.*—Cells oblong or fusiform, entire, placed side by side in a single row, but during division into two rows. Six species.

(Ralfs and Jenner, *British Desmidieæ;* Siebold, *On Unicellular Plants and Animals*, in *Mic. Journal*, 1853; Meneghini, *On the Animal Nature of Diatomaceæ*, translated by Ray Society, 1854; A. Braun, *On Rejuvenescence in the Plant*, translated by Ray Society, 1854; Lindley, *Vegetable Kingdom*; Nägeli, *Gattungen einzelliger Algen physiologisch und systematisch bearbeitet*, Zurich, 1849; Cohn, *On the Natural History of Protococcus pluvialis*, translated by Ray Society, 1854.)

DESMOPHY'LLUM, a genus of Fossil Radiate Animals belonging to the Zoophites found in the London Clay of Sheppey. ('Geol. Trans.,' N. S., vol. v. t. 8, f. i.)

DESVAUXIA'CEÆ, *Bristleworts*, an obscure and little known natural order of Plants, consisting of a few Australian sedge-like herbs, of no known utility. They are nearly related to *Restiaceæ* and *Eriocaulaceæ*, and are principally charaterised among other Glumose Endogens by having several carpels placed in the middle of each flower. The most recent character is the following, given by Endlicher in his 'Genera Plantarum':—

Dwarf Australian herbs with the appearance of a pigmy *Cyperus* or *Scirpus;* the roots fibrous or fasciculated. Culms filiform, undivided, leafless. Leaves radical, between thread-shaped and bristly, sheathing at the base. Spikelets hermaphrodite, in two ranks, 1-flowered, or terminal and solitary with one or many florets. Glume single, anterior, or two nearly opposite each other, coarse. Paleæ none, or delicate, single or double, parallel with the glumes. Stamen single, anterior. Filament filiform, simple. Anthers turned inwards, 1-celled, attached by the back above the base. Ovary either single and sessile (we would exclude this character) or several attached to a common axis at different heights, imbricated downwards, 1-celled. Ovule solitary, suspended from the apex of the ovary, orthotropous, with the foramen regarding the base of the ovary. Styles filiform, simple, united to each other at the base. Stigmas simple, or with a feathery beard. Utricles membranous, dehiscing lengthwise at the side. Seed orthotropous, pendulous; skin leathery and rather hard. Albumen fleshy and abundant. Embryo antitropous, lenticular, applied to the albumen at the extremity of the seed opposite the umbilicus; the radicular extremity papillose, and regarding the base of the fruit. ('Genera Plantarum,' p. 119.)

There are 4 genera and 15 species in this order.

DETRI'TUS and DEBRIS, two words now universally received into the language, the former of Latin, the latter of French origin. They are very frequently employed in works of geology and physical geography, when treating of the formation of alluvial deposits. By Debris, in geological language, is meant generally the fragments of rocks, boulders, gravel, sand, trunks of trees, carcasses of animals, &c., detached from the summits and sides of mountains by the effect of the elements, or resulting from sudden convulsions at the surface of the earth. By Detritus we understand the same Debris finely comminuted or pulverised by attrition. Debris in general comprises Detritus; but Detritus excludes the idea of the larger Debris.

Modern Debris seldom extends beyond the foot of the mountains whence it is derived, the channels of torrents, and the higher parts of the beds of rivers; Detritus alone, except in the case of such things as float, being carried down to the mouths of large streams. The boulders which lie strewn over such great extents of land, and which are found at great depths below the surface-soil, together with fossil-trees, bones of animals, &c., are the Debris of a former age, no cause now in action being apparently capable of bringing them to such distances from their original sites.

DEUTZIA, a genus of Plants belonging to the natural order *Philadelphaceæ*, inhabiting the North of India, China, and Japan. The tube of the calyx is campanulate, tomentose, the limb 5- or 6-cleft. The petals 5 or 6, and oblong. The leaves are opposite, petiolate, ovate, acuminated, serrated, wrinkled, and veined.

D. scabra has its leaves covered with stellate siliceous hairs, which makes them very rough, and renders them of use to cabinet-makers as polishing agents. The siliceous bodies are beautiful objects viewed by reflected light under the microscope.

DEVIL IN A BUSH, } Vulgar names of the genus *Nigella.*
DEVIL IN A MIST, } [NIGELLA.]

DEVIL'S APPLE. [MANDRAGORA.]

DEVIL'S BIT, the vulgar name of *Scabiosa succisa.* [SCABIOSA.]

DEVIL'S LEAF. [URTICA.]

DEVONIAN SYSTEM. A great portion of the Palæozoic Strata of North and South Devon has been thus termed by Sedgwick and Murchison ('Geol. Trans.'), and also referred to as of coeval formation with the Old Red-Sandstone of Herefordshire. Further investigation has shown that a portion of the strata in North Devon belongs to the Carboniferous System, and is equivalent to the lowest shales and sandstones thereof. The Old Red-Sandstone must certainly be admitted to be coeval with some parts of the Devonian Strata, which besides contain several red-sandstone members; but there is reason to think that the true place of much of the stratification of South Devon, on the ordinary geological scale, is rather about the upper part of the Old Red-Sandstone; and this mode of viewing these rocks harmonises with the distribution of organic remains in the Silurian, Devonian, and Carboniferous Deposits.

The following table by Professor Sedgwick gives at one view the relation of the rocks which enter into the composition of the Devonian Formation:—

Lower or Plymouth Group.	Dartmouth Slate, Plymouth Limestone and Red Grit, and Liskeard Slate.
Middle or Caithness Group.	Hereford Sandstone, Marl, and Cornstone, Dipterous Flag.
Upper or Petherwin Group.	Petherwin Slate and Clymenia Limestone, Marwood Sandstone.

The Devonian Formation is represented in Belgium and the Rhenish provinces, in Russia, America, and probably also in Van Diemen's Land.

With regard to the development of this great system, Mr. Jukes says—"The history of the production of the Devonian Rocks seems to be this:—At the close of the Silurian period, or during its later portion, great dislocations and elevations took place, by which the Silurian Rocks, and especially the Lower Silurians of the larger and more northerly portions of the British Islands, became much broken and contorted, and in many places lifted up into dry land. Granite was protruded into them in the south-east of Ireland, and probably also the granites of the north-east of Ireland and of the north of England and south of Scotland, were formed at this time. Great denudations also took place, by which some of the granite of the south-east of Ireland (if not that of the other districts) was brought to the surface. Upon the uneven ground thus formed, as it was slowly depressed again, the Old Red-Sandstone was deposited, consisting largely of the detritus produced by this denudation.

"But in the south-west of Ireland and England neither disturbance nor denudation took place to anything like the same amount, the locality remaining probably a pretty deep sea, in which fine-grained mechanical and some chemical depositions were formed, partly contemporaneously with the Old Red-Sandstone proper, and partly subsequent to it.

"If we are allowed to continue this hypothetical history a little longer, we should say that at the close of the Devonian period a subsidence of almost the whole country had occurred, and in the sea thus formed was deposited the Carboniferous Limestone, resting in level sheets on the floor of the Old Red-Sandstone, that had filled up and levelled the hollows and inequalities in the older rocks. When the Carboniferous Limestone had been formed, the Coal-Measures were accumulated on the top of it, setting in first of all as thick sandy deposits, and then as alternations of sandy and shaly beds, with an occasional bed of coal. The depression being suspended, and the sea, having been partially filled by the accumulation of the Carboniferous Limestone, was made still shoaler by the sandstones and shales of the Millstone Grit and Coal-Measures, so that, according to some, it was entirely filled up to its surface, in order to produce a bed of coal, while every one agrees that it must have nearly been so.

"Depression then recommenced, allowing the accumulation of several thousand feet of coal-measures, all successively produced in comparatively shoal water."

(Jukes, *Physical Geology*.)

DEWBERRY, a kind of bramble, the *Rubus cæsius* of botanists. [RUBUS.]

DEWEYLITE, a name for Serpentine. [SERPENTINE.]

DEXAMINE, a genus of Amphipodous *Crustacea*, established by Dr. Leach. The following are its characters:—Antennæ 3-jointed, the last segment composed of a number of minute joints; first segment shorter than the second; upper antennæ longest. Eyes oblong, not prominent, inserted behind the superior antennæ. Legs fourteen; first and second pairs monodactyle, with a small compressed hand; other pairs furnished with simple claws. Tail, on each side, with three double styles; above, with one small style on each side. Body, (including the head) 12-jointed. (Leach.)

D. spinosa. Body shining, the ninth, tenth, eleventh, and twelfth segments produced into a spine; front produced and bent downwards between the antennæ. The first joint of the upper antennæ beneath, towards their tips, have a little spine-like process. Length three-quarters of an inch. (Leach.)

Dr. Leach says that it is very common on the southern coasts of England, and is often taken by the shore-net, or beneath stones amongst the rocks at low tide. The legs, he observes, are easily broken, which will account for Montagu's having described and figured it (*Cancer* (*Gammarus*) *spinosus*) without the monodactyle hands.

DEXIARIÆ, a family of Dipterous Insects of the section *Creophilæ*. This family, established by M. Robineau Desvoidy, is composed chiefly of Meigen's genus *Dexia*. The species may be distinguished from those of neighbouring groups by the greater length of their legs: the body is generally elongated and cylindrical, but sometimes thick, depressed, or rounded. The fore part of the head is, in most of the species, furnished with a ridge situated between the deep grooves in which the antennæ are placed; the antennæ are rather short, and the stylet is generally plumose; the eyes are separated in both sexes, and the males are usually larger than the females. These flies are of inoffensive habits; they are usually seen on flowers, the juices of which afford them nourishment.

The chief characters of the genera contained in the *Dexiariæ* are thrown into a tabular form by M. Macquart, in the following manner:—

Genus 1. *Prosena*, St. Fargeau.

Proboscis long.
Proboscis short.
Body cylindrical.
First posterior cellule of the wings closed.
Second and third joints of the antennæ of equal length.

Genus 2. *Zeuxia*, Meigen.

Third joint of the antennæ longer than the second.

Genus 3. *Dinera*, Desvoidy.

First posterior cellule of the wings open.
Antennæ not extending to the epistoma.

Genus 4. *Dexia*, Meigen.

Antennæ extending to the epistoma. Legs very long.

Genus 5. *Scotiptera*, Macquart.

Body tolerably broad, depressed.
Fore part of the head arched (colours brilliant).

Genus 6. *Rutila*, Desvoidy.

Fore part of the head flat (colours, black or yellow).
Stylet of the antennæ naked.

Genus 7. *Gymnostyla*, Macquart.

Stylet of the antennæ covered with fine hairs.

Genus 8. *Omalogaster*, Macquart.

Of the genus *Prosena* Macquart describes only two species, one of which inhabits Europe, and the other is from Brazil.

Of the genus *Zeuxia* but one species is known.

The genus *Dinera* contains five species, one of which inhabits Brazil, and the others are found in various parts of Europe.

The genus *Dexia* contains twelve species, almost all of which are European.

The genus *Scotiptera* contains two species; they are of considerable size, and inhabit Brazil.

Rutila.—The species of this genus appear to be confined to Australia; they are generally of large size.

The genus *Gymnostyla* contains three species, two of which are from Brazil and the third is from Surinam.

The last genus, *Omalogaster*, contains four species, all of which are inhabitants of Europe.

DEXTRINE is a vegetable substance found in the interior of the cells of plants. It can be artificially procured by treating starch with diastase. Mulder has shown that dextrine may also be obtained from cellulose both by sulphuric acid and by diastase. The quantity of diastase required is extremely minute; if too much be used, or the process continued too long, grape-sugar is produced. It is by these or similar means that nature converts cellulose into dextrine, and dextrine or starch into sugar. As in malting barley, diastase is naturally produced with the starch, there is no reason why it should not in a similar manner be produced in the growing plant, and thus convert the cellulose into dextrine. [DIASTASE.]

The sap of nearly all plants contains a certain amount of dextrine, which, having the same chemical composition ($C_{12}\ H_{10}\ O_{10}$) as gum, and in many other points resembling it, has been in most analyses put down as gum. If one equivalent of water (HO) be taken from one equivalent of cellulose ($C_{24}\ H_{21}\ O_{21}$), two equivalents either of gum or dextrine [$2\ (C_{12}\ H_{10}\ O_{10})$] are formed. Thus a part of the cellular membranes may be converted into dextrine by catalysis without destroying the cells, if the vegetable sap, while passing through them, contains only a very minute quantity of diastase, or of a substance resembling it.

Gum and dextrine have been frequently confounded. The most important difference between them is, that the latter may be changed into grape-sugar by sulphuric acid or diastase, while the former is incapable of undergoing that change.

Dextrine belongs to that class of matters which are taken into the blood; all the starch taken as food being converted by the gastric juice into it. The gums are not taken up; they become mere excretions, and are apparently of little or no importance.

There seems every reason for believing that dextrine is the source of the cellular matter, for it is a universal constituent of all parts of plants. We are justified in assuming that the sap of plants must contain the elementary matter of cellulose in a state of solution, so as to be able to penetrate through the cell-walls, and to supply new substance to increase the number of cells. No material but dextrine is fitted for this office, though in young plants sugar also contributes to it. By the production, during germination, of dextrine and sugar, we are led to believe that the cellulose of the young plant is really formed from this dextrine and from the sugar in the germinating cotyledons. Whilst many full-grown plants do not contain sugar, all contain dextrine, so that the use of the latter in the formation of cells cannot be doubted.

Dextrine is not merely a source of cellulose, but likewise of starch, sugar, gum, and perhaps other vegetable substances; it is almost as valuable to plants as protein is to animals, for it is a constituent from which their organism derives its most important products. The composition of dextrine being $C_{12}\ H_{10}\ O_{10}$, the formation of cellulose is accomplished by every two equivalents of dextrine taking up one eqivalent of water. Thus

$$2\ (C_{12}\ H_{10}\ O_{10}) + HO = C_{24}\ H_{21}\ O_{21} = \text{Cellulose.}$$

Starch and gum contain the same elements in the same proportions as dextrine, and hence for their production require merely a re-arrangement of the molecules. For an account of the relation of Dextrine to the other secretions of plants, see the article SECRETIONS, VEGETABLE.

DIA'COPE, a genus of Fishes belonging to the section *Acanthopterygii* and family *Percidæ*, and belonging to that section of the family in which the species have less than seven branchiostegous rays, and an interrupted lateral line.

This genus is allied to *Serranus*, but may be distinguished by there being a notch or emargination in the lower part of the preoperculum, into which is fitted a projecting tubercle.

Many large and beautiful species of this genus inhabit the Indian seas. *Diacope octolineata*, a very beautiful species, caught off the coast of the Mauritius, is of a brilliant reddish-yellow colour, shaded into white on the belly, and is adorned with four longitudinal blue stripes on each side of the body; these stripes are margined with black. It is about 10 inches in length.

Some of the species are known to have attained the length of 3 feet and upwards.

DIADE'LPHIA, the seventeenth class in the Linnæan system of arranging plants. Strictly speaking it ought to contain no genera but those which have their stamens united into two equal or unequal parcels; but as it consists principally of Leguminous genera it is customary to place in it all the Papilionaceous plants which have united stamens, whether in one parcel or two. This and similar plans render the Linnæan system more natural, but destroy its use as an artificial guide to the determination of the name of a plant.

DIADEMA. [CIRRIPEDIA.]

DIALLAGE. [AUGITE.]

DIAMOND, a crystalline gem, which, on account of its high lustre and extreme hardness, has always been regarded as the most valuable of the precious stones; the former of these qualities arises from its great refractive power, and on account of its hardness its lustre remains undiminished. It is commonly colourless or grayish, but sometimes green, yellow, red, brown, blue, and black; the two last-mentioned colours are the rarest. Its lustre is adamantine; refraction single; transparent, but sometimes rendered opaque by foreign matter. Hardness 10, exceeding that of any other, and scratching every other substance; owing to its hardness it can be cut, or rather worn down, only by rubbing one diamond against another, and it is polished by the friction of portions of the gem itself reduced to powder: it is broken without difficulty. The specific gravity of the diamond is from 3·48 to 3·55; streak grayish; fracture conchoidal; cleavage parallel to the planes of the regular octahedron, which is its primary form, subject however to numerous varieties, and the faces are frequently curvilinear. When rubbed it phosphorises, and becomes positively electrical, and is therefore a non-conductor of electricity. When heated, without the contact of air, it suffers no change, but if ignited in contact with it, it is totally converted into carbonic acid gas, proving that it is carbon in a state of purity.

For ornamental purposes diamonds are cut into two shapes: namely, Rose-Diamonds and Brilliants, the former being, for the most part, made out of the octahedral crystals, and the latter from those with curvilinear faces. The weight and consequently the value of diamonds are estimated in carats, each of which is equal to 3·166 grains. In the formation of either a brilliant or a rose-diamond so much is cut away that the weight of the polished gem is not more than half that of the rough crystal out of which it was formed.

Newton, considering the fact that transparent bodies which are uninflammable refract light nearly in the ratio of their density, while those which are inflammable have refractive powers that are greater than their density, was led to conclude that the diamond, on account of this great refractive power, was "probably an unctuous substance coagulated."

In 1695 experiments were made at Florence, which proved the diamond to be dissipated by intense heat in the focus of a burning lens. Several chemists proved that diamonds lost no weight when heated without the contact of air, and on the contrary, that they were dissipated when heated in it; but it was first shown by Lavoisier that carbonic acid was obtained by the combustion of the diamond, and he concluded that it contained carbon, and had great analogy with this combustible body.

These researches were not however sufficient to afford complete proof of the nature of the diamond; but this was accomplished by the succeeding experiments of Smithson, Tennant, Guyton Morveau, Allen and Pepys, and Davy, who all arrived at the same conclusion, which is, that although there exists in many respects so great a difference between the properties of the diamond and charcoal, they are identical in their chemical nature. Thus, whenever by combustion 6 parts of charcoal, or an equal weight of diamond, are combined with oxygen, the quantity of oxygen absorbed always amounts to 16 parts, and the result of their combustion is 22 parts of carbonic acid.

Diamonds occur in India in the district between Golconda and Masulipatam, near Panna, in Bundelcund, also on the Mahanuddy, and in Ellore. They have been obtained in Borneo, on the west side of the Ratoos Mountain, with gold and platina. The Brazilian mines were first discovered in 1728, in the district of Serra do Frio, to the north of Rio de Janeiro. The largest diamonds are procured on the river Jequitinhonha, which is called the Diamond River, also Rio Pardo. In the Ural Mountains diamonds were detected in 1829, by Humboldt and Rose, in their journey into Siberia. In the United States the diamond has been met with in Rutherford county, North Carolina, and Hale county, Georgia. They have been found on the river Ginul, in the province of Constantine, in Africa. They have also been discovered in Australia, and of such size as to render it probable they may add yet more to the mineral treasures of that country.

The rocks in which the diamond occurs in Brazil are either a ferruginous quartzose conglomerate, or a laminated granular quartz called *Itacolumite*. The latter rock occurs in the Urals, and diamonds have been found in it; and it is also abundant in Georgia and North Carolina. In India the rock is a quartzose conglomerate.

In most instances diamonds are obtained from alluvial washings. In Brazil the sands and pebbles of the diamond streams are collected and washed under a shed by a stream of water passing through a succession of boxes. A negro washer is stationed at each box. When a diamond is found weighing 17½ carats the negro is entitled to his liberty.

"The largest diamond of which we have any knowledge is mentioned by Tavernier as in the possession of the Great Mogul. It weighed originally 900 carats, or 2769·3 grains, but was reduced by cutting to 861 grains. It has the form and size of half a hen's egg. It was found in 1550, in the mine of Colone. The diamond which formed the eye of a Brahminican idol, and was purchased by the empress Catharine II. of Russia from a French grenadier, who had stolen it, weighs 193 carats, and is as large as a pigeon's egg. The Pitt, or Regent Diamond, is of less size, weighing but 136·5 carats, or 419½ grains; but on account of its unblemished transparency and colour it is considered the most splendid of Indian diamonds. It was sold to the Duke of Orleans by Mr. Pitt, an English gentleman, who was governor of Bencolen, in Sumatra, for 130,000*l*. It is cut to the form of a brilliant, and is estimated at 125,000*l*. Napoleon placed it in the hilt of his sword of state. The Raja of Mattan has in his possession a diamond from Borneo weighing 367 carats." (Dana.)

The great diamond mentioned in the above extract as in the possession of the Great Mogul appears to be the identical diamond which, under the name of Koh-i-Noor, excited so much attention at the Great Exhibition in 1851. Some doubt is thrown on Tavernier's statement of its being cut. This precious gem has seen a variety of fortunes. Its early history is mythical. From the Great Mogul it passed into the possession of the reigning family of Cabul. When Shah Suja was driven from Cabul he became the nominal guest and actual prisoner of Runjet Sing, who spared no means to obtain possession of the precious gem. In this he succeeded in 1813. After the death of Runjet the diamond was preserved for a while by his successors. It was occasionally worn by Khunuk Sing and Shire Sing. After the murder of the latter it remained in the Lahore treasury until the supercession of Dhuleep Sing and the annexation of the Panjab by the British government, when the civil authorities took possession of the Lahore treasury, under the stipulation previously made that all the property of the state should be confiscated to the East India Company, in part payment of the debt due by the Lahore government and of the expenses of the war. It was at the same time stipulated that the Koh-i-Noor should be surrendered to the Queen of England. It arrived in this country on the 30th of June, 1850, and on the 3rd of July was presented to her Majesty. Since its public exhibition in 1851 it has been submitted to the process of cutting, which has much enhanced its beauty and value.

The diamond is cut by taking advantage of its cleavage, and also by abrasion with its own powder, and by friction with another diamond. It is a process of great labour, and many hours are spent in producing a single facet. Diamonds were first cut in Europe in 1456 by Louis Berquen, a citizen of Bruges.

The diamond is used for cutting glass. [DIAMOND, in ARTS AND SC. DIV.] It is also employed for the lenses of microscopes. It has but little chromatic aberration, but the frequent irregularity of its structure is a drawback to its employment for this purpose.

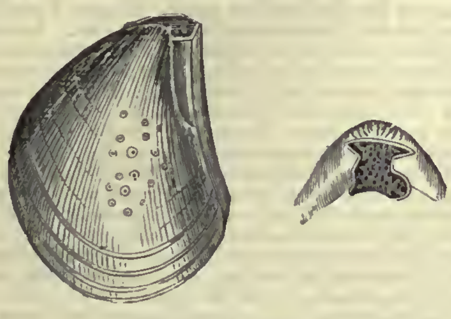
(Dana, *Manual of Mineralogy*; *Catalogue of Great Exhibition of* 1851, Class xxiii.)

DIAMOND-BEETLE. [CURCULIO.]

DIANÆA. [ACALEPHÆ.]

DIA'NCHORA, a Fossil genus of *Conchifera* allied to *Spondylus*, established by Mr. Sowerby in his 'Mineral Conchology.' It has the following characters:—Shell delicate, adherent, regular, symmetrical, equilateral, subauriculated, inequivalve; one valve hollowed within, convex without; the other flat. Hinge consisting of two distant condyles.

Cuvier ('Règne Animal') places the genus between *Pachytes* and *Podopsis*, M. de Blainville between *Plagiostoma* and *Podopsis*, and M. Rang between *Pecten* and *Pedum*. M. Deshayes, in his edition of Lamarck, after observing that *Pachytes* had been formed at the expense of *Plagiostoma*, states that his examination of the species had satisfied him of the identity of the genera, and that the same examination instituted with regard to *Dianchora* had convinced him that the characters of the last-named genus were identical with those of *Pachytes* and *Podopsis*. A further inquiry terminated in the conclusion that the so-called genera, *Podopsis*, *Dianchora*, and *Pachytes*, were only *Spondyli*, whose internal lamina had been dissolved, and had left naked the external or conical lamina. [SPONDYLUS.] The subjoined cut will convey to the reader the form of one of the so-called species.



Dianchora striata.

Four species of this genus have been found in the Chalk and Green-sand :—*D. lata*, Sowerby; *D. obliqua*, Mantell; *D. striata*, Sowerby; *D. truncata*, Lamarck.

DIA'NDRIA, the second class in the Linnæan system of arranging plants. It comprehends all genera with flowers having only two stamens, provided the stamens are neither united at their base, nor combined with the style and stigma, nor separated from the pistil.

DIANTHUS, a beautiful genus of Silenaceous Dicotyledonous Plants, with a calyx closely covered at the base by two, three, or four opposite pairs of decussating rigid sharp-pointed bracts. The petals are always more or less lacerated at the end, and in some species are divided into fine capillary segments. There are 10 stamens, 2 styles, and the capsule is 1-celled, with numerous black seeds containing a straight embryo. In all cases the leaves are long, narrow, 1-ribbed, sharp-pointed, and destitute of all lateral reticulated veining. De Candolle enumerates 113 species, of which some must undoubtedly be reduced to simple varieties. They are found in all the temperate parts of Europe and Asia, from Ireland to the eastern coast of China and Japan; two have been met with in the United States of America, and four at the Cape of Good Hope. Most of them are perennial herbaceous plants with permanent leaves and stems, and hence they ought perhaps to be considered under-shrubs; a few become woody and form genuine bushes.

D. barbatus, the Bearded Pink or Sweet William, has aggregate flowers in bundles; calycine scales ovate, awl-shaped, equal in length to the tube; the petals bearded; leaves lanceolate and nerved. It is a native of the south of France and Germany, in gravelly or sandy places. The flowers are very variable in colour, from dark purple to white, or variegated or speckled, single and double. Sweet William is a very favourite and old-fashioned inhabitant of the garden, and was much esteemed in the time of Gerarde for its beauty.

D. Caryophyllus, the Carnation, is a native of the south of France, and in England on old walls in Kent and Norfolk. It has solitary flowers; the calyx-scales broadly obovate, pointed, four times shorter than the tube; the leaves with smooth linear margins; the petals crenate, dentate, ovate, glabrous; the stem barren, elongated, procumbent, branching; the seeds pyriform, nearly flat; the flower-stems are from 12 to 18 inches high; the calyx-teeth not ciliated, longer than the capsule. The flowers are of all colours, excepting blue: in the British species they are of a pale pink, and in all cases fragrant. The flowers of the variety of this species, known as the Clove-Pink, are used to give a colour and fragrance to an officinal syrup used in pharmacy. A small variety of the species is known by the name of Picotees.

D. plumarius is the type of the Common Garden-Pink. It is a native of Europe, and is found in England on old walls and ruins. It has solitary flowers, two or three on a stem; the calyx-scales are roundish-ovate, shortly mucronate, four times shorter thau the tube; the leaves rough at the margin, linear, subulate; the petals digitate, multifid as far as the middle, with the central entire part obovate, downy; the stem barren, procumbent, rooting, much-branched; tho seeds flat, orbicular, with a point on one side; the flowering stems are from 6 to 12 inches high; the calyx-teeth are ciliated at the margin, slightly shorter than the capsule. The flowers are either double or single, white, pink, spotted, or variegated, and sweet-scented.

Of the species of this genus six are British, and are described by Mr. Babington in his 'Manual of British Botany.'

For the cultivation of the Carnation, Pink, &c., see PINK, in ARTS AND SC. DIV.

DIAPENSIA'CEÆ, *Diapensiads*, a very small natural order of Monopetalous Exogenous Plants, formerly referred to *Convolvulaceæ*, but in reality are more nearly allied to *Loganiaceæ* and *Stilbaceæ*. Only two genera, *Diapensia* and *Pyxidanthera*, are known; they consist of small depressed half-shrubby species, with the habit of a minute-leaved *Phlox*. Their calyx grows in a broken whorl; the corolla has an imbricated æstivation with five lobes, and as many stamens growing from its margin in the sinuses; the anthers have a broad connective, and burst transversely; the ovary is 3-celled, with a good many ovules growing upon central placentæ; finally, the embryo lies across the hilum, in the midst of fleshy albumen. No use has hitherto been made of these plants. (Lindley, *Vegetable Kingdom.*)

DIAPHRAGM (Διάφραγμα), *Septum Transversum*, *Transverse Partition*, *Midriff*, a circular Muscle, placed between the thorax and abdomen, forming a moveable partition between these two great cavities. Its borders, which are broad and fleshy, are moveable; its central portion, which is tendinous, is fixed and immoveable. When not in action, its upper surface, or that towards the thorax, is convex, presents the appearance of an arch, which reaches as high as the fourth rib, and is covered by the pleura, the membrane which lines the cavity of the thorax. Its under surface, or that towards the abdomen, is concave, and is covered by the peritoneum, the membrane which lines the cavity of the abdomen. It is perforated by several apertures, through which important organs pass from the thorax into the abdomen, and from the abdomen into the thorax. In its tendinous portion, between what is called its crura, or legs, there is an oval aperture through which the aorta, or great artery of the trunk, passes from the thorax into the abdomen, and the thoracic duct enters from the abdomen into the thorax. A little above this and to the left of it, in the fleshy portion of the diaphragm, is an aperture through which the œsophagus passes in its course from the mouth to the stomach. On the right side of the diaphragm, in its tendinous portion, is a third aperture, through which the inferior vena cava passes from the abdomen to the heart.

The diaphragm is a muscle of extreme complexity in its structure, and next to the heart performs the most important function of any muscle in the body. Its most important office is connected with tho function of respiration, and it is the principal agent both in enlarging the cavity of the thorax in inspiration and in diminishing it in expiration. These actions it performs by virtue of the power of alternate contraction and relaxation which it possesses in common with all muscles. When in the state of relaxation, as in expiration, its broad lateral moveable borders present an expanded arch, the convexity of which reaches, as has been stated, as high as the fourth rib; when in action, as in the state of inspiration, the fibres composing the lateral borders contract, whence this moveable partition descends, until from the form of an arch it presents a plane surface, increasing the capacity of the thorax by all the space that intervenes between the fourth rib and the lowest point to which the diaphragm is capable of descending. The fibres then relaxing, the moveable borders are pushed up by the contraction of the powerful muscles of the abdomen, until the diaphragm again assumes the form of an arch, diminishing the capacity of the thorax by all the space that intervenes between the lowest point to which it descends and the fourth rib. These alternate actions, which are performed in regular and uninterrupted succession, day and night, during our sleeping and our waking hours, from the moment of birth to that of death, constitute the principal portion of the mechanical part of the function of respiration or breathing, by which air and blood flow to and from the lungs. During these actions the central portion of the diaphragm, on which the heart rests, and to which the pericardium is attached, never moves; so that though the diaphragm is in constant motion it never disturbs the action of the heart, which it assists in supporting, and the function of the circulation is not disordered by the movements which are indispensable to the function of respiration.

There is a fixed relation between the action of the diaphragm and of the abdominal muscles. When the diaphragm contracts tho abdominal muscles relax; when the abdominal muscles relax the diaphragm contracts. The diaphragm is the antagonist of the abdominal muscles in inspiration; but it acts in concert with them in vomiting, in the discharge of the contents of the bowels and of the urinary bladder, and in assisting the expulsion of the fœtus in parturition. To produce the respiratory movements, and to assist in the expulsion of the fæces, the urine, and the fœtus, may be considered the natural and regular offices of the diaphragm; but it conduces to the performance of many other actions. It is the principal agent in vomiting, yawning, coughing, laughing, crying, and in hiccup, which may be regarded as its more powerful and irregular actions.

For diagrams representing the position of the diaphragm and its relation to the other organs of the body, see ABDOMEN and HEART.

DIASPORE, a Mineral. It is a dihydrate of alumina, and occurs massive and crystallised. Its primary form is a doubly oblique prism. The colour is slightly greenish-gray and yellowish-brown. Its hardness is 6·0 to 6·5. It is slightly translucent. The specific gravity is 3·43. It is found at Kosoihrod in the Orenburg government of Asiatic Russia. The massive variety occurs in slightly curvilinear laminæ of a shining pearly lustre and greenish-gray colour; also in cellular masses, constituted of slender crystals, which have a pearly lustre, and intercept each other in every direction; of a brown hue externally, but prefectly transparent and colourless when reduced to thin laminæ. The following is an analysis by Hess:—

Alumina	85·14
Water	14·56

The brown variety, analysed by Children, gave—

Alumina	76·06
Water	14·70
Oxide of Iron	7·78
Loss	1·46

DIASTASE, a substance formed during the germination of plants. It can be artificially prepared by reducing freshly germinated barley into a pulp, with half its weight of water, and then pressing out the liquor strongly. To the clear liquid just sufficient alcohol is to be added to destroy its viscidity and allow of its being filtered; by this an azotised substance is precipitated, which must be considered as vegetable albumen, since it coagulates at 167° Fahr. Having separated this, alcohol is again to be added as long as the liquid becomes turbid; the precipitate is to be purified by solution in water and precipitation by alcohol repeatedly; the precipitate is at last to be dried in thin layers upon glass at a temperature between 104° and 122° Fahr.

The properties of diastase are the following:—It is solid, white, not crystalline, soluble in water, but insoluble in alcohol unless it be weak; the aqueous solution is nearly tasteless, and without any chemical action, not precipitating subacetate of lead. The aqueous solution quickly changes, becoming acid: dry diastase undergoes the same change in a longer time, but when boiled in water the alteration is immediate. Common malt is stated in general not to contain more than 1-500th of its weight of diastase: one part of it is sufficient to convert 2000 parts of starch, thickened with water, into a mixture consisting of much dextrine and a little sugar. It has not yet been obtained absolutely pure. There can be little doubt that diastase is one of the forms of protein; and its reaction upon starch is not different from that which takes place with some other forms of the same substance. Schleiden includes it amongst the nitrogenous substances of plants, to which he gives the name Schleim (mucus).

(Schleiden, *Principles of Scientific Botany*, p. 23.)

DIA'STYLIS, a genus of Crustacean Animals established by M. Say.

It has the following characters.—Four antennæ placed nearly on the same line; the intermediate antennæ bifid, having a peduncle of three joints, the external simple, with the first joint long, and without a scale. External jaw-feet very large, pediform, very much approximated to the front, with the first joint long and compressed, and the others very small, cylindrical, and nearly equal. Corselet smooth, of six segments, of which the first, larger than all the others together, is terminated anteriorly by a short obtuse triangular rostrum, crenelated on its lateral edges. Six pairs of bifid feet; those of the first pair truncated at the end, and shorter than the external jaw-feet; those of the second terminated in a point; those of the third, fourth, and fifth pairs raised, pointed, without a nail, and terminated by strong hairs. Abdomen narrower than the thorax, formed of six segments, the last two of which support the natatory feet. Tail biarticulated, provided on each side of the first segment with a single bifid style, and on the extremity of the second with a simple cylindrical style.

D. arenarius. Length one-fifth of an inch. It is an inhabitant of the coasts of Georgia and Florida.

M. Say is of opinion that the *Cancer scorpionides* of Montagu, from the English coasts, and the *C. Esca* of Gmelin, from those of Norway, ought to be referred to this genus.

DIATOMACEÆ, or DIATOMEÆ, a group of organised beings which naturalists have placed in the animal and vegetable kingdoms, according as they have regarded their structures as most allied to the one kingdom or the other. These organisms consist of a single cell, and are remarkable for possessing a hard shell-valve or frustule, which is composed of silex or flint, and which remains permanent after its organic tissues have perished.

The following is a definition of this group of beings by one of the most recent writers on this subject:—Plant a frustule; consisting of a unilocular or imperfectly septate cell, invested with a bivalve siliceous epidermis. Gemmiparous increase, by self-division; during which process the cell secretes a more or less siliceous connecting membrane. Reproduction, by conjugation, and the formation of sporangia. (W. Smith.)

The *Diatomaceæ* are endowed with the power of motion; and when this function was supposed to be peculiar to the animal kingdom, it is not to be wondered at that the first observers of these organisms referred them to the animal kingdom. Ehrenberg, in his great work on the 'Infusorial Animalcules,' greatly enlarged our knowledge of this family, and added to the forms that were already known. He regarded them, as well as the *Desmidieæ*, and other beings which are now generally referred to the vegetable kingdom, as animals. The following are the principal points on which he relied for assigning to them this position:—

1st. The *Diatomaceæ* exhibit a peculiar spontaneous movement, which is produced by certain locomotive organs.

2nd. A large number of them have in the middle of the lateral surface an opening about which round corpuscles are situated, which become coloured blue when placed in water containing indigo, just as many of the Polygastic *Infusoria*.

3rd. The shells of the *Diatomaceæ* resemble in structure and conformation those which are seen in the *Mollusca* and other animals.

These arguments are met on the other side by the statement, that spontaneous movement is now known not to be specially animal, as the spores of many *Algæ*, and their entire fronds are known to be actively motile. In the next place the colouring of the interior by indigo also takes place in truly vegetable structures.

The complex structure of the minute siliceous frustules of the *Diatomaceæ* is a fact that has struck many observers. It certainly is without a parallel in the vegetable kingdom. Schleiden in his 'Principles of Scientific Botany,' after giving a minute analysis of the siliceous structure of *Navicula viridis* (*fig.* 6 represents this genus), says, "Such an artificial and complicated structure amongst plants has no explanation and is entirely without significance. In all true plants we find the silica present in a very different form, as minute scales or drops, and distributed through the substance of the cell-wall." Again, in another place he says, "This curious structure is wholly without analogy in the vegetable kingdom, and cannot be derived from the laws of vegetation with which we are at present acquainted."

More recently Professor Meneghini has come forward as an advocate of the animal nature of *Diatomaceæ*. In a very lucid and remarkable essay, published at Venice in 1845, he says:—

"If we suppose them to be plants, we must admit every frustule, every navicula, to be a cell. We must suppose this cell with walls penetrated by silica, developed within another cell of a different nature, at least in every case where there is a distinct peduncle or investing tube. In this siliceous wall we must recognise a complication certainly unequalled in the vegetable kingdom. It would still remain to be proved that the eminently nitrogenous internal substance corresponded with the gonimic substance, and that the oil-globules could take the place of starch. The multiplication would be a simple cellular deduplication (sdoppiamento), but it would remain to be proved that it takes place, as in other vegetable cells, either by the formation of two distinct primitive utricles or by the introflection or constriction of the wall itself. Finally, there would still remain unexplained the external motions and the internal changes, and we must prove Ehrenberg's observations on the exterior organs of motion to be false. But, again, admitting their animal nature, much would remain to be investigated, both in their organic structure and their vital functions; excepting this, so far as we know, we have only one difficulty to overcome, that of the probably ternary non-azotised composition of the external gelatinous substance of the peduncles and investing-tubes. But as the presence of nitrogen is not a positive character of animal nature, so the absence of it is not a proof of vegetable. And in order that the objection should really have some weight, it would be well to demonstrate that this substance is isomeric with starch. For then, supposing all the arguments in favour of the animal nature of *Diatomeæ* were proved by new and more circumstantial observations, this peculiarity, if it deserve the name of objection, might still be regarded as an important discovery. We should then have in the animal as well as in the vegetable kingdom a ternary substance similar to that forming the basis of the vegetable tissue."

Of the chemical composition of the *Diatomaceæ* little satisfactory has at present been made out. Professor Frankland of Manchester, according to the Rev. W. Smith, whose work on the British *Diatomaceæ* is one of the last that has hitherto been published, has found that a large amount of iron exists in the state of a silicate or protoxide in the siliceous frustules, which probably accounts for the brown or yellow colour of these organisms. On the application of tincture of iodine the internal membrane contracts on its contents, and converts these from a golden-yellow to a bright green. On the addition of sulphuric acid they exhibit a deep brown hue.

The fact which is most relied on to support the vegetable nature of the *Diatomaceæ*, by those who advocate this view, does not appear to have been known to Meneghini, and that is the conjugation of the cells of which they are composed in the same manner as in the *Desmidieæ*. [DESMIDIEÆ.] This discovery was made by Mr. Thwaites, and observed in species of *Eunotia* (*fig.* 1), in *Epithemia gibba* and *E. turgida* (*fig.* 19), *Fragilaria pectinalis*, and other species. This process takes place as follows:—Two individuals closely approximated dehisce in the middle of their long diameter, whereupon four protuberances arise, which meet four similar ones in the opposite frustule. These indicate the future channels by which the endochrome of the two frustules becomes united, as well as the spot where subsequently the double sporangium is developed (*figs.* 8, 19). From the sporangium the new individuals are developed. This process is precisely analogous to what takes place in the *Desmidieæ*, so that the frustules of the Diatoms must be regarded as cells of the same individual. "If we duly consider this fact," says Mr. Thwaites, "how much does it exalt the lower tribes of plants in our estimation! since we may contemplate an individual plant of them not as the single phyton—not as the single frond—not as the single cell—but it may be as the aggregate of thousands of these;—view it occupying as much space and exercising as great an influence in the economy of nature as the largest forest-tree!"

The mode by which the cells are multiplied amongst the *Diatomaceæ* appears to be strictly in accordance with what occurs generally in the vegetable kingdom. This process is one of self-division. The first step is the fission or division of the internal cell, "probably by the doubling-in of its membranous wall, and consequently the separation of the endochrome, or cell-contents; the central vesicle or cytoblast also dividing into two parts, which remove to a little distance from each other; these movements being simultaneous with a retrocession of the epidermal valves and the formation of the siliceous connecting-membrane already described. In the centre of the enlarged frustule, in exact apposition to the original valves and closely applied to them, there are now found two new valves, covering the surface of the cell-membranes along the line of fission. The divided portions of the endochrome spread themselves along the membrane which is embraced by the new valves, and there result two half-new frustules bound together by the connecting-membrane, generated during the process we have described.

"During the healthy life of the Diatom the process of self-division is being continually repeated; the two half-new frustules at once proceed to divide again each into two frustules, and thus the process continues. I have been unable to ascertain the time occupied in a single act of self-division, but supposing it to be completed in twenty-four hours, we should have, as the progeny of a single frustule, the amazing number of one thousand millions in a single month; a circumstance which will in some degree explain the sudden or at least rapid appearance of vast numbers of these organisms in localities where they were but a short time previously either unrecognised or only sparingly diffused." (Smith, p. 25.)

1. *Eunotia Diadema.* 2. *Eupodiscus sculptus.* 3. *Triceratium Favas.* 4. *Surirella biseriata.* 5. *Synedra gracilis.* 6. *Navicula elegans.* 7. *Pleurosigma angustatum.* 8. *Cocconema lanceolatum*, portion representing conjugation. 9. *Gomphonema geminatum.* 10. *Meridion circulare.* 11. *Bacillaria paradoxa.* 12. *Achnanthes longipes.* 13. *Striatella impunctata.* 14. *Diatoma vulgare*, the frustules united. 15. *Biddulphia pulchella.* 16. *Melosira varians*; the enlargement is peculiar to the genus; *a*, side view. 17. *Dickieia ulvoides*; *a*, frustule; *b*, frond. 18. *Schizonema Smithii*; *a*, frustule; *b*, ditto; *c*, frond, natural size; *d*, frond magnified. 19. *Epithemia turgida*, illustrating the process of conjugation. From a drawing by Mr. West.

The structure of the siliceous portion of the *Diatomaceæ* is the most remarkable part of their organisation. The following is Meneghini's account of this organ:—

"Every Diatom is formed of a siliceous shield and a soft substance therein contained. According to Kützing, this shield consists of pure silica, or, in some cases, perhaps, of silica combined with alumina. Nägeli further says that the silica is deposited in the outside of an organic membrane, which he believes to be of a vegetable nature. In fact, an organic membrane ought to exist, for the silica could not become solid except by crystallising or depositing itself on some pre-existing substance. On the other hand, we cannot admit, with Nägeli, that it has been deposited externally; for in many genera, and especially in the *Achnanthidia*, the siliceous shield is covered with a very delicate dilatable membrane, itself containing silica, as is proved by its sustaining unchanged the action of fire and acids. Therefore, comparing this shield with other organic formations, whether animal or vegetable, containing in like manner either silica or some other so-called mineral element, we may reasonably consider it to be formed of an organic tissue permeated by silica. This permeation may occur either in the wall of a simple cell, as is seen in the epidermal cells of many plants, or within minute cells, as in various plants and animals. The action of heat or of acid, in these cases, destroying the organic matter and leaving the silica untouched, does not alter the apparent form of the organ, because the skeleton remains unaltered.

"Externally to the shield Kützing observed a thin stratum which he denominated cement, which may be made visible either by desiccation or by calcination; and produces either a simple opacity, or lines, points, and maculæ, sometimes irregularly disposed, sometimes regularly. He supposes it to be a silicate of iron or of alumina. Independently of the chemical materials which it may contain, this outside integument seems to me the more important inasmuch as even without resorting to the means indicated by Kützing, I observe it to be constant, not merely in the species enumerated by him, but also in many others, and I could almost assert that it exists in all. For to me it appears to correspond with that fine membrane of the *Achnanthidia* above mentioned, which, according to Kützing's own observations, is always visible whenever the two new individuals (into which every Diatom is resolved in its multiplication by deduplication) (sdoppiamento) begin to separate. The lines and points supposed to belong to the subjacent shield belong very frequently to this kind of covering.

"The shield itself is formed of at least four pieces, or valves, united together in a four-sided figure—a tetragon. The mode of union is unknown. But the existence of a kind of articulation which permits an opening and closing, like the valves of a shell-fish described by Corda in a species of *Surirella*, has been denied by other observers. Be this as it may, whether spontaneous after death or induced by external means, this separation does take place in a regular manner. Now, if we suppose an organic cell with a wall permeated by silica, and with a four-sided figure, we can easily suppose that all the sides will mechanically support each other. Moreover, we shall meet with numerous facts by a different kind of analogy, namely, that with solid animal tissues belonging either to the internal skeleton or the external tegument.

"The four valves are equal in length, but in many species and genera one pair exceeds the opposite pair in breadth. In order to establish an uniform language it is convenient to term those primary valves or surfaces which exhibit along the middle the line of division in the act of deduplication, which, since it is formed here in a normal manner, runs parallel to the other two surfaces, denominated lateral. Along the primary surfaces we frequently see longitudinal lines, which terminate at the two extremities in small apertures. From their internal surface there project into the cavity linear marks variously formed but always longitudinal: these are termed vittæ.

"The lateral surfaces have frequently a round aperture of greater or smaller size in the centre, and from this a fissure extends towards each extremity. This fissure either loses itself gradually or expands into the regular terminal apertures. When this occurs each of these surfaces is divided into two distinct valves. On these lateral surfaces we observe the striæ, lines, and transverse costæ, no less admirable for their beautiful appearance than for their constant regularity in number, direction, and proportion. When many individuals are united together to form one compound being, like a polyp for instance, it is always by the lateral surfaces that they touch each other; and since all other characters sometimes fail, we can affix to them the denomination 'lateral' from this principal one.

"Besides the vittæ before mentioned, in some genera (*Biddulphia*, *fig.* 15, *Climacosphenia*, *Terpsinoë*) there are other solid substances in their internal cavities: these are variously arranged.

"These essential peculiarities of the shield may perhaps be regarded as indicating a complex structure, very different therefore from what would be prescribed by a simple cellular wall. Ehrenberg deduces from it an argument to compare it with the shell of *Mollusca*. The *Arcellinæ* may be cited among the *Infusoria*. Kützing states, in reply, that among vegetable cells there is found a peculiar conformation of the walls, with prominences, depressions, points, lines, papillæ, and perforations, disposed in a regular manner; he refers to grains of pollen, as an instance. He might have added the more appropriate instance of the *Desmidieæ*, which would be very closely allied to the *Diatomeæ*, if the latter, like the former, could be referred to the vegetable kingdom. If not equal in constancy and regularity, the *Desmideæ* display a greater degree of complication; and we must remember the different nature of their substance, for in the vegetable cell, when lime or silica predominates, the wall becomes uniform and regular (?) (uniforme ed irregolare)."

The siliceous epiderm presents an extraordinary variety of forms, which in every genus and species offer the best possible means of distinction and identification: striæ, or lines frequently moniliform, dots arranged in a radiate or concentric manner, and minute divisions presenting perfectly hexagonal outlines, are amongst the most frequent occurrences. Great difference of opinion exists as to the nature of these. Mr. Smith says, "I am disposed to regard them all as modifications in the arrangement of the silex of the valve, arising from the mode of development peculiar in each case to the membrane with which the silex is combined." He also denies that there are any perforations in the valve, as supposed by Ehrenberg and Kützing. These foramina are also denied by Schleiden. Mr. Smith denies also that the valves are externally covered with any organic membrane.

The delicacy of the markings on many of the *Diatomaceæ* render them objects peculiarly adapted for testing the powers of the object-glasses of the microscope. The following table, drawn up by Messrs. Sollitt and Harrison of Hull, to whom microscopy is indebted for having first pointed out this method of testing the powers of the microscope, was presented by them at the meeting of the British Association at Hull in 1853:—

Focal length of object glass.	Species.	Striæ in inch.	Angle of Aperture.
$\frac{1}{2}$	*Navicula strigilis*	34·000	40°
$\frac{1}{4}$	*N. Hippocampus*	42·000	60°
	N. Spencerii	50·000	70°
	N. liniata	60·000	80°
	N. angulata	60·000	80°
$\frac{1}{8}$	*N. strigosa* (large)	70·000	90°
	N. strigosa (small)	80·000	95°
	Ceratoneis Fasciola	90·000	110°
	Navicula sigmoidea	105·000	120°
$\frac{1}{12}$	*N. arcus*	130·000	150°

The *Diatomaceæ* possess the power of moving. "The cells have no special organs for these movements. But as, in consequence of their nutritive processes, they take in and give out fluid matters, the cells necessarily move when the attraction and the emission of the fluids is unequally distributed on parts of the surface, and is so active as to overcome the resistance of the water. This motion consequently is observed more particularly in those cells which, in consequence of their taper forms, easily pass through the water; these cells moreover move only in the direction of their long axis. If one-half of a spindle-shaped or ellipsoidal cell chiefly or exclusively admits material, the other half, on the contrary, giving it out, the cell moves towards the side where the admission takes place. But, as in these cells both halves are physiologically and morphologically exactly alike, so it is that it is first the one and then the other half which admits or emits, and consequently the cell moves sometimes in one, sometimes in the opposite direction." (Nägeli.)

This is perhaps as satisfactory an explanation of these movements as can be given in the present state of our knowledge. All observers agree that they can find no evidence to support Ehrenberg's notion of a pedal or motile organ projected from the interior of the siliceous shield. The Rev. W. Smith has also detected cyclosis in the *Diatomaceæ*. "A distinct movement," he says, "of the granular particles of the endochrome, closely resembling the circulation of the cell-contents in *Closterium Lunula*, noticed by Mr. Ralfs [DESMIDIEÆ], and which I have frequently detected in the same species, has occasionally fallen under my notice in some of the larger forms of *Diatomaceæ*." He has observed it in *Surirella biseriata*. (*Fig.* 4.) "This circulation," he continues, "has not however the regularity of movement so conspicuous in the *Desmidieæ*, and is of too ambiguous a character to furnish data for any very certain conclusions, save one, namely, that the Diatom must be a single cell, and cannot contain a number of separate organs, such as have been alleged to occupy its interior; since the endochrome moves freely from one portion of the frustule to another, approaching and receding from the central nucleus, unimpeded by any intervening obstacle."

The *Diatomaceæ* are the most abundant and extensively distributed of unicellular organisms. They are found in the ocean, at the mouths of rivers, in brackish waters, in rivers, lakes, ponds, ditches, pools, and cisterns. In fact, wherever a few drops of water are allowed to remain exposed to the air, we may expect to find forms of *Diatomaceæ*. Their forms are not less abundant than their presence. In the first volume of his 'Synopsis of the British Diatomaceæ,' the Rev. W. Smith has described upwards of 220 species, and the second will contain nearly 100, so that the number of species known in Great Britain is considerably above 300. The facility with which their forms are preserved, give to these objects a great advantage, and a handful of sand from the sea or mud from a river in the most remote district of the world may be expected to reward the observer with an abundance of new forms. They occur in great abundance in the river Thames, and its mud affords a large variety of the frustules of those which have ceased to exist. In a report on the 'Microscopical Examination of the Thames and other Water,' by Drs. Lankester and Redfern, upwards of forty species were observed.

The mode of collecting living specimens for observation is simply to allow the water in which they exist to stand for a few hours, when, by carefully decanting the water, a portion remains at the bottom of the vessel more turbid than the rest, and which generally contains in large numbers the objects sought for.

In describing showers of coloured dust which have occurred in various parts of the world, Ehrenberg has demonstrated that various forms of *Diatomaceæ* have been found present. In some seasons these organisms occur in such numbers in the waters of rivers as to give to their banks a peculiar physical aspect. In the autumn of 1841 the stones and pebbles in the nearly dried-up bed of the Annan, in Dumfriesshire, presented an appearance as though they were white-washed. The substance which gave the stones this appearance could be scraped off, and looked like some form of calcareous matter. On submitting this powder to the microscope, Dr. Lankester found that it consisted entirely of the siliceous shields of a species of *Synedra*. (*Fig.* 5.) In the first volume of the new series of the 'Transactions of the Microscopical Society,' Mr. Shadbolt has given an account of the examination of portions of mud given him by Mr. Busk from Port Natal. This mud was recent, and from the nature of the specimens in it, Mr. Shadbolt thinks it probable that it was obtained not far from the mouth of some river. In this mud he made out fifty-five distinct species of *Diatomaceæ*, twenty of which he has described as entirely new species. In the 'Microscopical Journal' for July 1853, Mr. Brightwell of Norwich has described nine new species of one genus—*Triceratium*. Six of these are recent. He says, "We have detected nearly all the recent species described in this memoir in material obtained from the surface of the large sea-shells of the genera *Hippopus* and *Haliotis* before they have been cleaned. Many of them in this state are covered with small zoophytes, minute algæ, and other parasites; and by a careful examination of these, *Triceratia* and other *Diatomaceæ* have been obtained."

One of the most singular positions in which Diatoms are found is in the guano brought from America and Africa. Their history is curious. They must first have been swallowed by fish and subsequently by birds; their shields however have been able to withstand this double process of digestion, and they are found in large numbers in every pure specimen of guano. Some of the forms which have been thus presented to the naturalist are entirely new, and are amongst the most singular of the family. It has been suggested that the silex thus introduced into the guano may contribute to its fertility, as it is well known that this substance is present in the stems of all our cereal grasses, and is necessary to their growth.

If they occur thus abundantly in recent deposits, it would be expected that they should be found in many of the older formations of the earth's surface. This is very extensively the case; although it may be doubted whether, from the fact of their being occasionally found in igneous rocks, that they were amongst the first organisms on the earth's surface. Ehrenberg has been able to detect their presence in some of the earliest rocks of the Palæozoic series. How *Diatomaceæ* may be present in igneous rocks has been suggested by Dr. Hooker. During his voyage with Sir James Ross in the Antarctic Ocean he says, "This order occurred in such countless myriads as to stain the sea every where of a pale ochreous-brown, in some cases causing the surface of the ocean, from the locality of the ships, as far as the eye could reach, to assume a pale-brown colour." This immense mass of organisms perishing are producing a sub-marine deposit, or bank, of vast dimensions, resting on the shores of Victoria Land, and hence on the sub-marine flanks of Mount Erebus, an active volcano upwards of 12,000 feet high. "Knowing as we do that *Infusoria*, *Diatomaceæ*, and other organic constituents, enter into the formation of the pumice and ashes of other volcanoes, and are still recognisable in those minerals, it is perhaps not unreasonable to conjecture that the subterranean and subaqueous forces which kept Mount Erebus in activity, may open a direct communication between this Diatomaceous deposit and its volcanic fires."

Ehrenberg has described a large number of forms of *Diatomaceæ* from the oolite, cretaceous, and other secondary rocks. A formation occurring in Barbadoes, and described by Sir Robert Schomburgk in the 'Reports of the British Association' for 1847, furnished him with an entirely new group of beings apparently related to this family. The following is Sir Robert's account of this discovery:—

"In the white marls and other rocks of Scotland district, Professor Ehrenberg of Berlin discovered a new and great group of siliceous-shielded animalcules, which, in a report read before the Royal Academy of Sciences, he described as *Polycystina*. The regular apertures and articulation of the minute shells which cover these animalcules distinctly bespeak an independent animal structure and development. They possess large apertures at the extremity of the body, which has no analogy among plants, but occur very commonly among animals. These siliceous loricated organic forms from the rocks in Barbadoes differ alike from *Polygastrica* and *Polythalamia*, but develop an important relation to these two groups, which Professor Ehrenberg considers, not upon conjecture but from actual investigation, to form two separate types. They approach most nearly in systematic arrangement to *Polythalamia*, and would occupy a separate group among animals possessed of vessels but without a heart and pulsation, and provided with a simple tubular intestinal canal. The forms developed in the highest degree in that division would be *Holothuriæ* and *Echinoideæ*.

"The minute forms of organic life in the rocks of Barbadoes, as far as investigated by Professor Ehrenberg in February, 1847, consist of the following groups:—

	Species.
Polycystina	282
Polygastrica	18
Phytolitheria	27
Geolithia	27
Polythalamia	7
	361

Of these more than 300 are new forms.

"The great discovery of the *Polycystina*, which might be almost called a new class, since they amount to upwards of 280 species, a larger number of specific forms than is contained in some classes of animals, may guide us to form an idea of the geological age of the rocks in Scotland district, by comparing these forms with similar fossil animalcules from rocks upon the age of which geologists have agreed. Ehrenberg considers that the *Polycystina* from the rocks of Barbadoes resemble more the animalcules from rocks of the secondary period than the tertiary."

Amongst the varieties of quartz rock the mineralogist recognises, under the name of tripoli and polishing powder, certain pulverulent and earthy forms of silex. On placing these substances under the microscope they are found to be entirely composed of the siliceous frustules of *Diatomaceæ*. The polishing powder or slate (polirschiefer) found at Bilin in Bohemia is used for the purpose of producing a polish on fine surfaces. The angularity and hardness of the frustules of the Diatoms well adapt them to this purpose.

Another deposit in which the *Diatomaceæ* have been found in great abundance is the Bergmehl of Sweden. [BERGMEHL.] The Diatoms found by Ehrenberg in this formation are principally species of *Navicula*. (*Fig.* 6.)

Amongst the tertiary deposits, beds of *Diatomaceæ* are very common. They have been observed in Italy, in Germany, and in several of the States of America. "The city of Richmond in Virginia is said to be built upon a stratum of Diatomaceous remains, 18 feet in thickness." (Smith.) Professor Gregory of Edinburgh has recently described, in the 'Transactions of the Microscopical Society,' a Diatomaceous earth, discovered about two years ago by the Duke of Argyll in the Isle of Mull. It constitutes a bed resembling marl in appearance, lying in a rough piece of ground between Loch Baa and the sea. The lake is about 30 feet, the land about 40 feet, above the sea-level. At one part there is a hollow, which in winter used to become a small loch, in summer only a stagnant pool, and in draining this the bed of marl was discovered. The bed rests upon gravel, which appears to belong to the diluvial period, and the Diatomaceous earth is probably of recent origin. Professor Gregory has examined the contents of this earth with great care, and has given a list of upwards of 130 species, which he has been able to make out ('Quarterly Microscopical Journal,' January, 1854). Of these upwards of 20 are altogether new species, or species that are new in a British locality.

From these facts it will be seen that the subject of fossil *Diatomaceæ* promises an almost boundless field for further inquiry. It appears that we may say of these organisms, what we can say of no other family or group of organised beings, that once created they exist for ever. Myriads of species of soft-bodied animals have perished, never to be recognised, but each individual cell of the Diatom leaves its siliceous wall as a record of its existence—a record that the ordinary forces of nature seem to have little or no power in obliterating.

We now turn to the subject of arrangement. It would of course be impossible here to give any account of individual species, and systematic arrangements are being constantly modified by new discoveries. The following is an arrangement of the families or tribes by Kützing:—

Tribe I. STRIATÆ.

Order I. *Astomaticæ*.

Without a central opening on the secondary valve.

* Transverse striæ unbroken.

Family 1. *Eunotieæ*.
Family 2. *Meridieæ*.
Family 3. *Fragilarieæ*.

** Striæ broken (interrupted) in the median line.

Family 4. *Meloseireæ*.
Family 5. *Surirelleæ*.

Order II. *Stomaticæ*.

With the central opening.

α *Monostomaticæ*.

Having a median aperture on only one of the two secondary surfaces.

Family 6. *Cocconeideæ*.
Family 7. *Achnantheæ*.

β *Distomaticæ*.

With a median aperture on each secondary surface.

Family 8. *Cymbelleæ*.
Family 9. *Gomphonemeæ*.
Family 10. *Naviculeæ*.

Tribe II. VITTATÆ.

Order I. *Astomaticæ*.

Without central opening on secondary side.

Family 11. *Licmophoreæ*.
Family 12. *Striatelleæ*.

Order II. *Stomaticæ*.

With a large distinct aperture.

Family 13. *Tabellarieæ*.

Tribe III. AREOLATÆ.

Order I. *Disciformes*.

Family 14. *Coscinodisceæ*.
Family 15. *Anguliferæ*.
Family 16. *Tripodisceæ*.

Order II. *Appendiculata*.

Doubtful forms.

Family 17. *Biddulphieæ*.
Family 18. *Angulatæ*.
Family 19. *Actinisceæ*.

The Rev. W. Smith, in his 'Synopsis of the British Diatomaceæ,' gives the following arrangement of the genera:—

Tribe I. Frustules naked; not imbedded in gelatine nor inclosed in membranaceous tubes.

Sub-Tribe 1. Connecting membrane deciduous; frustules solitary, or during self-division in pairs; rarely in greater numbers, adherent or free, dispersed, or aggregated into a mucous stratum.

22 Genera—

Epithemia (*fig.* 19)	16 species.
Eunotia (*fig.* 1)	7 species.
Cymbella	6 species.
Amphora	8 species.
Cocconeis	6 species.
Coscinodiscus	3 species.
Eupodiscus (*fig.* 2)	5 species.
Actinocyclus	1 species.
Arachnodiscus	1 species.
Triceratium (*fig.* 3)	3 species.
Cyclotella	4 species.
Campylodiscus	7 species.
Surirella (*fig.* 4)	20 species.
Tryblionella	6 species.
Cymatopleura	5 species.
Nitzschia	23 species.
Amphiprora	5 species.
Amphipleura	2 species.
Navicula (*fig.* 6)	36 species.
Pinnularia	24 species.
Stauroneis	10 species.
Pleurosigma (*fig.* 7)	26 species.

Sub-Tribe 2. Connecting membrane subpersistent; frustules after self-division attached by a gelatinous cushion, or dichotomous stripes.

7 genera—

Synedra (*fig.* 5)	24 species.
Doryphora	2 species.
Cocconema (*fig.* 8)	4 species.
Gomphonema (*fig.* 9)	12 species.
Podosphenia	5 species.
Rhipidophora	3 species.
Licmophora	2 species.

Sub-Tribe 3. Connecting membrane evanescent, or obsolete; frustules after self-division united into a compressed filament.

12 Genera—

Meridion (*fig.* 10)	2 species.
Bacillaria (*fig.* 11)	1 species.
Himantidium	7 species.
Odontidium	4 species.
Denticula	4 species.
Fragilaria	3 species.
Eucampia	1 species.
Achnanthes (*fig.* 12)	6 species.
Diadesmis	3 species.
Rhabdonema	2 species.
Striatella (*fig.* 13)	1 species.
Tetracyclus	1 species.

Sub-Tribe 4. Connecting membrane subpersistent; frustules after self-division united into a zigzag chain.

6 Genera—

Diatoma (*fig.* 14)	4 species.
Grammatophora	2 species.
Tabellaria	2 species.
Amphitetras	1 species.
Biddulphia (*fig.* 15)	4 species.
Isthmia	2 species.

Sub-Tribe 5. Connecting membrane subpersistent as a siliceous annulus; frustules after self-division united into a cylindrical filament.

3 Genera—

Podosira	2 species.
Melosira (*fig.* 16)	6 species.
Orthosira	6 species.

Tribe II. Frustules invested with a gelatinous or membranaceous envelope.

Sub-Tribe 6. Frond indefinite; mammillate; frustules scattered.

1 Genera—

Mastogloia	3 species.

Sub-Tribe 7. Frond definite; compressed or globular; frustules scattered.

2 Genera—

Dickieia (*fig.* 17)	3 species.
Berkeleyia	1 species.

Sub-Tribe 8. Frond definite; filamentous; frustules in rows.

3 Genera—

Encyonema	2 species.
Colletonema	4 species.
Schizonema (*fig.* 18)	16 species.

Sub-Tribe 9. Frond definite, filamentous; frustules fasciculated.

1 Genus—

Homœcladia.*	3 species.

(Smith, *Synopsis af British Diatomaceæ*, vols. i. & ii.; Meneghini, *On the Animal Nature of Diatomeæ*, translated by Ray Society; Kützing, *Species Algarum*; Siebold, *On Unicellular Plants and Animals*, translated in *Quarterly Journal of Microscopical Science*, vol. i.; Pritchard, *A History of Infusorial Animalcules, Living and Fossil*; Dujardin, *Histoire Naturelle des Zoophytes Infusoires*; Hassall, *British Fresh-Water Algæ*; Ehrenberg, *Die Infusions-Thierchen*; Hooker, *British Flora*, vol. ii.; Agardh, *Conspectus Criticus Diatomacearum*; Papers in vols. i. & ii. of *Quarterly Journal of Microscopical Science*, by T. Brightwell, G. Shadbolt, Professor Gregory, Messrs. Sollitt and Harrison; Papers in *Annals and Magazine of Natural History*, by J. Ralfs, Rev. W. Smith, G. H. K. Thwaites; *Reports of British Association*; Professor J. W. Bailey in *Smithsonian Contributions to Knowledge*.)

DICÆ'LUS, a genus of Coleopterous Insects. [LICINUS.]

DICÆUM. [CERTHIADÆ; CINNYRIDÆ.]

DI'CERAS, a genus of Fossil Conchiferous *Mollusca*, allied in form to *Chama*. It includes species mostly occurring in the upper part of the Oolitic strata and (*D. Lonsdalii*) the lower part of the Greensand. D'Orbigny ranks the latter species as *Caprotina*. [CHAMACEA.]

DICHELASPIS. [CIRRIPEDIA.]

DICHELESTHIUM. [PŒCILOPODA.]

DICHOBUNE. [ANOPLOTHERIUM; PACHYDERMATA.]

DICHOLOPHUS. [ÇARIAMA.]

DICHO'TOMY, a term in Botany employed to express a mode of branching amongst plants by constant forking. The first stem or vein of a plant divides into two branches, each branch divides into two others, and so on. It is only in the veins of fern leaves, and of those of some of the species of *Coniferæ*, and in the stems of Ferns, that this mode of division exists as a general character. It however does occur elsewhere; for example, the Doom-Palm (*Crucifera Thebaica*) of Thebes is remarkable for its dichotomous branches, and the Screw-Pines (*Pandanus*) have a similar habit.

DICHROITE, a Mineral, also known by the names *Iolite*, *Peliome*, *Steinheilite*, and *Cordierite*. It is an anhydrous silicate of alumina, and occurs massive and crystallised. Its primary form is a right rhombic prism, commonly crystallised in 6 or 12-sided prisms. The cleavage is parallel to the lateral planes. It has a blue colour in the direction of the axis, and yellowish-gray perpendicular to it; sometimes dull yellowish in both directions. The streak is white. Fracture uneven and somewhat conchoidal. Its hardness is 7·0 to 7·8. Lustre vitreous. It is transparent and translucent. Its specific gravity is 2·56. The massive varieties are amorphous. Its structure is indistinctly granular. It is found at Cabo de Gata in Spain, in Greenland, at Bodenmais, in Bavaria, Norway, the United States, &c. The following is an analysis by Stromeyer:—

Silica	50·24
Alumina	33·42
Magnesia	10·84
Protoxide of Iron	4·00
Protoxide of Manganese	0·68
Water	1·66

* For the above illustrations we are indebted to the Rev. W. Smith not only for those published in vol. i. of his 'British Diatomaceæ,' but through Mr. Triffin West, the artist, for several from the unpublished volume of that admirable work. Mr. West has also furnished some original drawings.

DICLIDURUS. [CHEIROPTERA.]

DI'CLINOUS, an obsolete term in Botany, signifying that a plant has its sexes in distinct flowers. It comprehends all the Monœcious and Diœcious plants of Linnæus.

DICOTYLE'DONS, a Natural Class of Plants, deriving their name from the embryo having in general two seed-leaves, or cotyledons; a character to which there are however some exceptions. The genus *Ceratophyllum* has several: *Bertholletia* appears to have none; in *Tropæolum* and many others they are consolidated into one; and *Cuscuta* is certainly destitute of them. Like all others therefore the character derived from the cotyledons, nearly universal as it is, has its exceptions. Hence botanists associate with the character derived from the embryo others derived from the mode of growth, leaves, flowers, &c., and the whole taken together give the real diagnosis of the class to which the name of Dicotyledons is applied.

The stems of Dicotyledous are probably in all cases branched, except when a plant is from its weakness and minuteness unable to reach any development beyond that of the first stage from the plumule. In herbaceous plants that are called stemless, a sort of branching takes place by the formation of small short stems upon the crown of the axis of growth. They have the pith, wood, and bark distinctly separated, and the wood traversed by medullary rays. This wood if more than one year old consists of concentric circles, each of which is formed on the outside of that which immediately preceded it; the consequence of which is that the oldest part of a branch will necessarily consist of the largest number of layers, and will therefore be the thickest: hence the branches of Dicotyledons are always cones, although usually very long ones [EXOGENS], and not cylinders. But to some of these characters the exceptions are not a few. It is difficult to trace any distinction of pith, wood, and bark in the stem of the Water-Lily (*Nymphæa*); there are no concentric circles in the wood of *Aristolochia*, and several other genera; and it is impossible to show by measurement that the stems of many irregular tropical dicotyledonous climbers vary perceptibly in diameter for considerable distances.

The leaves of Dicotyledons are articulated with the stem, so that at a particular time they are thrown off, and leave a clean scar behind them, as in all the trees, whether deciduous or others, which are found in the open air in England. Their veins are repeatedly branched, so as to form a netted apparatus within the parenchyma. But although by far the largest part of Dicotyledons are thus constructed, yet we have contradictions to this also. For instance, in *Dianthus*, and a great many other genera, the leaves have no veins except the midrib, and there are many herbaceous plants whose leaves never drop fairly off the stems.

The number of parts in the flower of dicotyledonous plants is four or five; that is, four or five sepals, four or five petals, and the same number of stamens, present in either a complete or imperfect state; or if the number is greater it is some power of four or five. But in *Ranunculus*, *Ficaria*, most Anonaceous plants, and several more, the parts in the flower are three.

Finally, when the seeds germinate the embryo simply extends the point of its radicle in the form of a root to seek for nourishment in the soil. [EXORHIZÆ.] But although this is, as far as is yet known, a character without exception, nevertheless it has been too little studied for us to assert that it is more free from anomalies than other characters.

Hence it is to be observed that it is neither the two cotyledons, nor the exogenous stem, nor the concentric circles of wood, nor the reticulated disarticulating leaves, nor the quinary or quaternary flowers, nor the exorhizal germinations, which by themselves characterise the class of Dicotyledons, but the combination of those characters; and that the absence of some one of them is immaterial; so that a plant may be essentially a Dicotyledon, although it has any number of cotyledons except two.

The Dicotyledons of Jussieu comprehended the plants now separated under the name of Gymnosperms, and together with Monocotyledons and Acotyledons, constituted the whole vegetable kingdom. They probably consist of at least two-thirds of all known plants: in the state of trees, shrubs, or herbaceous plants, they are found wherever phænogamic vegetation can exist, and they and Gymnosperms together constitute exclusively the arborescent scenery of all cold countries.

DICOTYLES. [SUIDÆ.]

DICRURUS. [LANIADÆ.]

DICTAMNUS, the botanical name of the fragrant herbaceous plant called *Fraxinella* by gardeners. [FRAXINELLA.]

DICTY'OCHA, a genus of organised beings referred by Ehrenberg to the *Naviculaceæ* or *Diatomaceæ*. They are characterised by an areolate spinous shield, and differ so much from the other forms of *Diatomaceæ* that many naturalists have doubted the propriety of placing them there. The species are numerous, the larger number being fossil and found with various forms of *Diatomaceæ*.

DICTYOGENÆ, a class of Plants, proposed by Lindley, and adopted in his 'Vegetable Kingdom.' It embraces a number of orders standing between the larger classes of Exogens and Endogens. They have a monocotyledonous embryo, but they have also a broad net-veined foliage, which usually disarticulates with the stem. The following are the natural orders of *Dictyogenæ* :—

Flowers unisexual. Perianth free. Carpels 00 ; one seeded	*Triuridaceæ.*
Flowers unisexual. Perianth adherent. Carpels consolidated ; several seeded	*Dioscoreaceæ.*
Flowers bisexual. Carpels several, quite consolidated. Placentæ axile. Flowers hexapetaloideous	*Smilaceæ.*
Flowers bisexual. Carpels several, quite consolidated. Placentæ parietal. Flowers 3-6-petaloideous	*Philesiaceæ.*
Flowers bisexual. Carpels several, half consolidated. Placentæ axile. Flowers 3-petaloideous . .	*Trilliaceæ.*
Flowers bisexual. Carpels solitary, simple, many-seeded, with long-stalked anatropal seeds, and a basal placenta	*Roxburghiaceæ.*

DICTYOPHYLLIA. [MADREPHYLLIŒA.]

DICTYOPHY'LLUM, a genus of fossil Plants, proposed by Lindley and Hutton ('Fossil Flora') to include a large specimen (*D. crassinervium*) from the New Red-Sandstone of Liverpool, and a more delicate species (*D. rugosum*) from the Oolitic shales of the Yorkshire coast. The latter is regarded as a fern by later writers. Its nervures are rudely reticulated.

DICTYOTACEÆ. [ALGÆ.]

DICYPELLIUM, a genus of Plants belonging to the natural order *Lauraceæ*. It has diœcious flowers, with a deeply 6-parted spread-out calyx, with equal permanent segments. The staminiferous flowers have 3 rows of sterile stamens; the 3 outer being perfectly petaloid, the 3 next petaloideo-unguiculate, inflexed at the point, with 4 pits below the point; the 3 inner compressed, sessile, truncate, with 2 pits on each side below the point, and 2 glandular protuberances at the back. The fruit is dry, and seated in the enlarged, fleshy, shrivelled calyx, and among the enlarged, hardened, sterile stamens. The inflorescence consists of single few-flowered racemes.

D. caryophyllatum, Bois de Rose, has alternate oblong leaves tapering to a very fine point, which is nevertheless bluntish, acute at the base, papery, and smooth-netted on the under side. It is a tree, and a native of the woods of Brazil and Guyana. It is called Licari Kanali by the Caribs; and is the *Licaria Guianensis* of Aublet. The bark gives out a smell very like cloves, and has a hot, clove-like, peppery taste. It is used as a medicine by the natives in the countries where it grows, and possesses powerful tonic properties.

(Lindley, *Flora Medica*.)

DIDELPHINA, a sub-family of *Marsupiata*. The whole of this sub-family have the inner toe of the hind foot converted into a thumb, destitute however of a claw, and this development is apparent in nearly all the species which have a scaly prehensile tail. Professor Owen remarks that in some of the smaller Opossums the sub-abdominal tegumentary folds are rudimental, or merely serve to conceal the nipples, and are not developed into a pouch; and in these the young adhere to the mother by entwining their little prehensile tails around hers, and clinging to the fur of her back; whence the specific name *dorsigera*, applied to one of the species. He further observes that few facts would be more interesting in the history of the *Marsupialia* than the condition of the new-born young, and their degree and mode of uterine development in these Opossums. Since the Marsupial bones serve not, as is usually described, to support a pouch, but to aid in the function of the mammary glands and testes, they are, he adds, of course present in the skeleton of these small pouchless Opossums, as in the more typical Marsupials. [MARSUPIATA.]

The term Opossums is generally used to designate the *Didelphina*, now confined to the American continents. The former existence of this type in Europe in association with *Palæotherium*, *Anoplotherium*, and other extinct pachydermatous quadrupeds, is proved by the fossil remains in the Paris Basin (Eocene of Lyell). Two species of *Didelphis* have been found fossil in Great Britain. [MARSUPIATA.]

The dentition of these scansorial Marsupials bears more resemblance to that of the Bandicoots (*Perameles*) than to that of the *Dasyuri*, if the structure of the molar teeth be excepted.

The following species of this family are contained in the 'British Museum Catalogue':—

Didelphis Virginiana, the Opossum. North America.
D. Azaræ, Azara's Opossum. Brazil.
Philander nudicaudus, Naked-Tailed Philander. Brazil.
P. Opossum, the Philander. Tropical America.
P. marsupialis, the Crab-Eater. Tropical America.
P. dorsigerus, Menair's Opossum. (See *fig.*).

P. cinereus, Cinereous Opossum. South America.
P. murinus, the Mamose. Tropical America.
Thylanus elegans, Elegant Painted Mamose. Chili, Valparaiso.
(Owen, *On the Classification of the Marsupialia*, *Zool. Trans*, vol. ii.)

Didelphis dorsigera (*Philander dorsigerus*, 'Brit. Mus. Cat.').
From the specimen in the British Museum.

DIDUS. [DODO.]

DIDYMOPRIUM. [DESMIDIEÆ.]

DIDYNA'MIA, the fourteenth class of the Linnæan system of arranging Plants. It is the same as *Tetrandria ;* that is, it has always four stamens, only two of them are a little longer than the other two. Under this class are comprehended a large part of the Lamiaceous, Verbenaceous, Scrophalariaceous, Bignoniaceous, and Acanthaceous Plants of modern botanists. It is divided into two orders, *Gymnospermia* and *Angiospermia*. *Gymnospermia* includes the genera whose ovary is split into four small seed-like lobes, which in the time of Linnæus were taken for naked seeds ; and *Angiospermia*, those which have manifestly the seeds inclosed in a pericarp of some sort.

DIEFFENBA'CHIA, a genus of Plants belonging to the natural order *Araceæ*, to which the *Caladium Seguinum*, Dumb Cane, belongs. [CALADIUM.]

DIERVILLA, a genus of Plants belonging to the natural order *Caprifoliaceæ*, consisting of a single North American species, by Linnæus considered a honeysuckle, and called *Lonicera Diervilla*. It is however obviously not of that genus, because its fruit is a dry capsule with a papery pericarp, with four cells and several seeds.

D. Tourneforti, or, as it is also called, *D. humilis*, *D. lutea*, or *D. Canadensis*, is a common hardy shrub, growing from two to three feet high, in a spreading manner, and having small funnel-shaped irregular 5-cleft yellow flowers, growing in stalked clusters of two or three from the axils of opposite ovate serrated leaves. It is found wild in rocky woods in the United States, from Canada to the Carolinas, flowering in June.

DIFFLUGIA. [INFUSORIA.]

DIGENITE, a native Sulphuret of Copper.

DIGESTION, the process by which the food is converted into nutriment. Taken in its whole extent the process of digestion comprehends the entire series of changes by which the crude aliment is assimilated into arterial blood. These changes are effected by organs which, viewed collectively, comprise a most extensive apparatus commencing at the mouth and ending at the lungs.

The first changes upon the food are effected in the mouth, where it is mixed with mucus and saliva. [SALIVA.] Torn to pieces by the teeth [TEETH] in the operation of mastication, and softened by the secretions of the mouth until it is reduced to a pulp, it is then collected by the tongue [TONGUE], and formed by that organ into a mass called a bolus. The bolus of food thus prepared is carried by the tongue to a muscular membranous bag called the pharynx [PHARYNX], situated at the back part of the throat. The pharynx, as soon as it receives the bolus contracts firmly upon it, and by a proper muscular action delivers it to the œsophagus, a long muscular tube which extends from the pharynx to the stomach. [STOMACH.] The bolus of food does not descend along the œsophagus by its own weight, for a person can swallow while standing on his head, and many animals have obviously to convey their food along the œsophagus against gravity. The food when it enters the œsophagus is transmitted along the tube by a powerful contraction upon it of the strong fasciculi of muscular fibres of which it is composed.

By the œsophagus the food is conveyed into the stomach, where it is converted into a fluid termed Chyme. The chyme when duly prepared in the stomach is transmitted to the small intestines, in the first portion of which it is converted into a new substance called Chyle. In its passage along the second portion of the small intestines the chyle disappears, being taken up by a set of vessels named lacteals, which convey it through a double series of glands, called the Mesenteric Glands, to the Thoracic Duct. By the thoracic duct it is conveyed through the abdomen into the thorax, where it is poured into one of the large veins, the Subclavian, which returns the blood from the upper parts of the body to the right side of the heart, to be, by the heart propelled into the Pulmonary Artery. By the pulmonary artery the chyle, now mingled with venous blood, is conveyed to the lungs, where it undergoes its ultimate change, and is converted into arterial blood. The large intestines meantime carry out of the body that portion of the food which has not been converted into chyle. All solid food undergoes the same process. [FOOD.]

The food torn, as has been stated, into minute fragments by the operation of mastication, softened and brought into the state of a pulp by its admixture with mucus and saliva, and raised nearly to the temperature of the blood by the warmth of the mouth, is received into an extensive chamber, the stomach, where it is constantly maintained at a temperature of 100° of Fahrenheit, and kept in a state of gentle but almost unceasing agitation by a peculiar motion of the stomach, effected by its muscular fibres, and called, from its striking resemblance to the motion of the earthworm, peristaltic. The essential phenomena which take place on the introduction of the food into the stomach are the following :—

The food on entering the stomach is not arranged indifferently in any part of the chamber, but is detained in the great extremity, or that portion of the stomach which is near the entrance of the œsophagus, termed the cardiac extremity. This portion of the stomach during the actual process of digestion appears to be cut off from the rest by a contraction of the circular fibres of the muscular coat, called the hour-glass contraction, by which about a third of the length of the stomach towards its small or pyloric extremity is separated from the great or cardiac extremity. The food received in the cardiac extremity is slowly dissolved ; this solution takes place at the surface ; "in proportion as it proceeds the dissolved part is rolled off the rest by the peristaltic action of the fibres of the stomach, and carried to the pyloric portion," where it accumulates. Thus the undissolved and the dissolved portions of the food are in different parts of the stomach ; the undissolved portion in the cardiac extremity, and the dissolved portion in the pyloric extremity.

A remarkable change takes place on the inner or mucous surface of the stomach the moment a portion of food comes in contact with it. This change has been seen to take place in the stomachs of animals laid open during the process of digestion for the purpose of affording an opportunity to observe the phenomena, and even in the human stomach, which, in more than one instance, has been completely exposed to view in consequence of wounds accidentally inflicted. The mucous coat of the stomach, which is of a pale pink colour when the stomach is empty, becomes of a bright red colour when excited by the contact of food. Over this reddened surface are visible, more especially when it is examined through a magnifying glass, innumerable minute lucid points, from which distils a pure limpid and colourless fluid. This fluid, as it is discharged, is absorbed by the aliment in contact with the surface of the stomach, or collects in small drops and trickles down the sides of the stomach to the more depending parts, and there mingles with the food and dissolves it. This fluid, the true solvent of the food, is termed the Gastric Juice or Acid. It has been ascertained to be the efficient agent in digestion, and its solvent power has been demonstrated by a series of most decisive experiments long ago performed by Spallanzani and others. This distinguished physiologist swallowed a metallic tube perforated with holes and filled with flesh ; he allowed the tube to remain in the stomach four hours, and then contrived to throw it up by exciting vomiting mechanically. The flesh in the tube was found to be thoroughly soaked with the fluid of the stomach ; its surface was in a dissolved state, being soft and gelatinous, and moreover it had wasted from 53 to 38 grains. Subsequently, Dr. Stevens induced a person practised in swallowing pebbles, to swallow a hollow silver sphere containing raw or cooked flesh, or vegetables, and perforated with holes that would admit a crow-quill : the sphere was voided in about forty hours perfectly empty. Next, Mr. Hunter observed that the great extremity of the human stomach is sometimes found after death in a softened state and even in a state of partial solution, the coats of the stomach being dissolved by its own gastric juice, and the edges of the opening appearing pulpy, tender, and ragged, and even the parts adjacent to the stomach, as the spleen, the diaphragm, and the lungs, being in like manner softened.

More recently, Dr. Beaumont, an American physician, has performed a series of experiments on the digestibility of various kinds of food, by introducing food directly into the stomach of a man—Martin St. Ange—who had a fistulous opening into that organ through the parietes of the abdomen. The results of his experiments are interesting, and are given in the following table. It appears that the articles were converted into chyle, that is, digested, in the times indicated :—

	H.	M.		H.	M.
Rice, boiled soft	1	0	Oysters, stewed . .	3	30
Apples, sweet and ripe .	1	30	Eggs, raw	2	3
Sago, boiled	1	45	Eggs, soft boiled . .	3	0
Bread, stale	2	0	Eggs, hard boiled . .	3	30
Milk, boiled	2	0	Beef, roast or boiled .	3	0
Cabbage	2	0	Beef, salted	5	30
Baked Custard . . .	2	45	Mutton, roast or boiled .	3	0
Parsnips, boiled . . .	2	30	Pork, boiled . . .	3	30
Potatoes, roasted . .	2	30	Pork, salt and boiled . .	4	38
Potatoes, boiled . . .	3	30	Pork, roast . . .	5	30
Turnips, boiled . . .	3	30	Veal, roasted . . .	5	30
Carrots, boiled . . .	3	15	Turkey and Goose . .	2	30
Butter and Cheese . .	3	30	Domestic Fowls . . .	4	0
Venison	1	35	Wild Fowls . . .	4	30
Oysters, raw . . .	2	3			

The solution of the food, which takes place during this process, is wholly different from the spontaneous resolution which warmth and moisture tend to produce in it. Exposure of the food to warmth and moisture decomposes it by the process of putrefaction ; but the gastric juice is antiseptic, and stops the putrefying process even after it is considerably advanced. The solution of the food by the gastric juice is a chemical operation, and the gastric juice is a chemical agent, the exact nature of which is not yet clearly ascertained. Spallanzani discovered that the gastric juice is of an acid nature. Some years ago Dr. Prout ascertained that muriatic acid is present. If meat and gastric juice be inclosed in a glass tube, and kept at the temperature of the human body, a product is obtained closely resembling the fluid formed by the solution of the food in the stomach. If meat be inclosed in a glass tube with diluted muriatic acid, and kept at the temperature of the blood, a perfectly similar product is obtained.

From experiments upon the dog it has been ascertained that muriatic acid is not present in the gastric acid of that animal. Its acid reaction is produced by superphosphate of lime. Lactic and acetic acids are also found present in human chyle. So we may state that up to the present time chemistry has not been able to decide whether the acid re-action of the gastric juice depends on free acids, acid salts, or acid organic compounds.

In addition to the acid, the gastric juice contains a substance called Pepsine. The properties of this substance have been principally studied in that form of it obtained from the mucous membrane of the pig, which is very like to that of man. [PEPSINE.] This substance, when combined with muriatic or acetic acid, has a very remarkable power in dissolving albuminous foods. "A liquid which contains only 17-ten-thousandths of acetate of pepsine and six drops of muriatic acid per ounce, possesses solvent power enough to dissolve a thin slice of coagulated albumen in the course of six or eight hours' digestion. With 12 drops of muriatic acid per ounce, the same quantity of white of egg is dissolved in two hours." (Carpenter.) These properties quite explain the action of the gastric juice upon the food.

After the food has undergone the action of the gastric juice, it loses its sensible properties, and is converted into the homogeneous semi-fluid mass which has received the name of chyme. Specific differences are distinguishable in chyme, according as the food from which it is formed has consisted of vegetable or animal matter, and according as it has contained fatty or oily substances, or has been destitute of them. Usually however it consists of a pultaceous mass of a grayish colour ; it has a sweetish taste, and is slightly acid. The character common to it, from whatever kind of food it may have been produced, and therefore distinctive of it, is its acidity.

The state of the food in the chyme has not been clearly made out. Dr. Carpenter gives the following account :—

"The protein compounds, whether derived from animal or vegetable food, are all reduced to the condition of albumen ; a part of which is dissolved, whilst another portion is suspended in a very finely-divided state. Gelatine will be dissolved or not, according to its previous condition; if it exist in a tissue from which it cannot readily be extracted it will pass forth almost unchanged, but when ingested in a state of solution it remains so, and if it have been previously prepared for solution by boiling, its solution is completed in the stomach. The gummy matters of vegetables are dissolved when they exist in a soluble form, as in the case of pure gum, pectine, and dextrine, or starch-gum. The degree in which starch, when its vesicles have not been ruptured by heat, is affected by the gastric fluid, seems to differ in different animals ; the Ruminants and Granivorous Birds apparently possessing the power of crushing or dissolving the envelopes of the starch globules, whilst they pass through the alimentary canal of other *Herbivora* unchanged, and may be detected entire in their excrements. Sugar is unquestionably taken up in solution, as such, in a healthy condition of the system, but it may undergo a previous change in the stomach in disordered states of the digestive process. Oily matters, whether of animal or vegetable origin, are reduced to the condition of an emulsion, being very finely divided, and their particles diffused through the chyme. Most other substances, as resins, woody fibre, horny matter, yellow fibrous tissue, &c., pass unchanged from the stomach, and undergo no subsequent alteration in the intestinal canal; so that they are discharged among the fæces as completely useless."

The chyme upon quitting the stomach passes into the duodenum, where it mingles with the Bile [BILE] and Pancreatic Juice. [PANCREATIC JUICE.] These fluids are not merely excretions, but exercise an influence upon the mass of chyme with which they are mingled. A part of the bile is probably taken up again into the system; and from the experiments of Barnard it would appear that the function of the pancreatic juice is to render the oily matters of the food miscible and fit for absorption.

After mixture with these fluids a spontaneous change takes place in the chyme. It separates into a whitish tenacious fluid termed Chyle, and into a gray pulp; the first is the nutritive part of the food, the second is its excrementitions portion. If fat or oil, whether of vegetable or animal matter, have formed part of the aliment, the chyle is of an opaque white colour, if not, it is of a grayish colour. It differs in its chemical character from chyme; for chyme is acid, chyle on the contrary is alkaline.

The following is the composition of the chyle, according to an analysis by Dr. G. O. Rees:—

Water	90·237
Albuminous Matter (coagulable by heat)	3·516
Fibrinous Matter (spontaneously coagulable)	0·370
Animal Extractive Matter (soluble in water and alcohol)	0·332
Animal Extractive Matter (soluble in water only)	1·233
Fatty Matter	3·601
Salts: Alkaline Chloride, Sulphate, and Carbonate, with traces of Alkaline Phosphate, Oxide of Iron	0·711
	100·000

The chyle, together with the excrementitious portion of the food, is slowly transmitted along the small intestines. The progress of the chyle is rendered slow, partly by its own tenacity, in consequence of which it adheres with some degree of firmness to the villi, and its progress is still farther retarded by the valvulæ conniventes, which act as partial valves. [INTESTINES, SMALL.] In its course through the small intestines the chyle gradually disappears, being absorbed by the lacteal vessels, so called from the milk-like fluid they contain. The lacteals commence on the surface of the villi. [LACTEALS.] Loaded with chyle, the lacteals penetrate the coats of the intestine, pass between the layers of the mesentery [MESENTERY], and enter the first order of mesenteric glands. In the mesenteric glands the lacteals unite freely with each other, and become exceedingly convoluted. On emerging from these glands the lacteals pass, still between the layers of the mesentery, on to the second order of mesenteric glands, which they enter, and in which they present the same convoluted appearance as in the first order. On emerging from the second order of mesenteric glands, the lacteals pass on to the receptacle of the chyle, which forms the commencement of the thoracic duct. [THORACIC DUCT.] In the receptacle of the chyle terminates another system of absorbent vessels, termed lymphatics, from the colourless and pellucid fluid, called lymph, which they contain. [LYMPH.] From the receptacle of the chyle the chyle and lymph commingled flow into the thoracic duct, by which tube they are transmitted through the abdomen and thorax to the left subclavian vein, where they are mixed with venous blood. Together with the blood contained in this great vein, the chyle and lymph are sent by a direct and short course to the lungs.

The result of the successive changes thus wrought upon the food by these progressive steps of the digestive process, is to approximate the crude aliment more and more nearly to the chemical condition of the blood. [BLOOD.] "This is accomplished partly by the gastric and intestinal juices, and partly by matters combined with the food, highly animalised in their own nature, and endowed with assimilative properties, as the salivary secretion mixed with the food during mastication; the pancreatic and biliary secretions mixed with the food during the conversion of chyme into chyle; the mesenteric secretions mixed with the elaborated chyle of the mesenteric glands; and, lastly, organised particles, which have already formed a part of the living structures of the body, mixed with the chyle under the form of lymph in the thoracic duct."

(Valentin, *Text-Book of Physiology*, translated by Brinton; Carpenter, *Manual of Human Physiology;* Müller, *Physiology*, translated by Baly.)

DIGITA'LIS, a genus of Exogenous Plants belonging to the natural order *Scrophulariaceæ*. It is distinguished by its 5-parted leafy calyx, its irregular funnel-shaped inflated corolla with an oblique limb, the upper lip of which is short and 2-lobed, the lower 3-lobed, and its ovate acuminate capsule, splitting into 2 many-seeded valves. The flowers in all the species are arranged in long racemes, are either yellow, purple, or brown, and generally showy; the leaves alternate upon a round herbaceous stem.

D. purpurea, Foxglove, is found all over the west of Europe, especially in England and France. It is a very handsome species, with large purple or white flowers. It is a biennal, with oblong stalked scalloped wrinkled leaves, gray with hairs, and a stem about two feet high, also covered with a close soft nap. The purple or white pendulous flowers are above an inch and a half long, and are arranged in one-sided racemes; in the inside of their corolla, on the lower lip, they are bearded with long hairs, and gaily spotted with blackish-purple specks. There are four didynamous stamens, shorter than the corolla, with large smooth anthers, 2-lobed at the base.

The energetic stimulating acrid narcotic properties of this plant have caused it to be extensively employed medicinally. For its action and properties, see DIGITALIS, in ARTS. AND SC. DIV.

There are about 25 species of this genus; most of them are showy garden flowers. The only one which is truly a British plant is the one described.

DIGITA'RIA, a genus of Grasses belonging to the tribe *Paniceæ*. It has fingered spikes, the spikelets in two rows on one side of a flattened rachis, unarmed, 1-flowered, with an inferior rudiment; the glumes 2, lower very small, upper 3-nerved; the sterile flowers of one 5-7 nerved palea, resembling the upper glume and equalling the flower. This genus has obtained its name from the singular form of its heads of flowers, which look like fingers. Two species are described as natives of Great Britain. *D. sanguinalis* was formerly found in Battersea Fields, near London, but is not a true native. It has the leaves and sheaths hairy, the flowers oblong-lanceolate, glabrous with downy margins. It is a common plant in Germany, and has obtained its specific name from an idle trick which the boys in some parts of Germany have of pricking one another's noses with its spikelets till they bleed. It abounds by the roadsides in Poland and Lithuania, in which countries its seeds are collected, and boiled whole like rice with milk, and is esteemed as a pleasant article of diet. The other species is *D. humifusa*. It has leaves and sheaths glabrous, flowers elliptical and downy, with glabrous nerves. This is a rare plant, and grows in sandy fields. Is is a true native in many parts of England. (Babington, *Manual;* Loudon, *Encyclopædia of Plants.*)

DIGITIGRADES. [CARNIVORA.]

DIGY'NIA, a systematic name given by Linnæus, in his artificial system, to such plants as have two styles, or a single style deeply cleft into two parts.

DILL, the common name of a species of *Anethum.* The genus *Anethum* belongs to the natural order *Umbelliferæ*. It has the following characters:—Calyx obsolete; petals roundish entire, involute, with a squarish retuse lobe; fruit lenticular, flattened from the back, surrounded by a flattened border; half-fruits (mericarps) with equidistant filiform ridges, the 3 dorsal acutely keeled, the 2 lateral more obsolete, losing themselves in the border; vittæ broad, solitary, filling the whole channel, 2 on the commissure. The species are annual plants, with upright smooth stems. Leaves much dissected, with setaceous linear segments. The flowers are of a yellow colour, and there is no involucre.

A. graveolens, the Common Dill, has the fruit rather more than two lines long, oblong, bright shining brown and convex at the back, paler and again convex at the edge, which is separated from the back by a deep hollow; dorsal ridges sharp, filiform, elevated, very distinct but fine; the commissure dull grayish-brown, with the tumid vittæ only indistinctly seen.

The fruit of the Dill, like that of many of the order, is carminative and stimulant. It may be taken with food as a condiment, but is more frequently employed for making a distilled water, for which there is a great demand in the nursery. Whether its popularity as a domestic carminative for children is dependent on any specific power is doubtful, and it is more than probable that other stimulants would act as favourably.

A. Sowa is a species found in the East Indies. It has properties of the same kind, but more powerful than the last, and is employed in Hindustan as an ingredient in curries.

(Lindley, *Flora Medica.*)

DILLENIA, a genus of Plants, the type of the natural order *Dilleniaceæ*. The young calyces of *D. scabrella* and *D. speciosa* have a pleasant taste and are used in curries by the inhabitants of Chittagong and Bengal. Several species of *Dillenia* are large trees, and afford hard durable and valuable timber.

DILLENIA'CEÆ, a natural order of Plants belonging to Polypetalous Albuminous Exogens, and related on the one hand to *Magnoliaceæ*, on the other to *Ranunculaceæ* and to *Anonaceæ*. They are briefly characterised by having 5 sepals in a broken whorl; 5 petals; an indefinite number of stamens; a definite number of ovaries, which are either quite distinct or more or less consolidated; berried or capsular and 2-valved fruits; seeds surrounded by a pulpy aril; and, finally, a minute embryo lying in solid fleshy albumen. Differentially considered, Dilleniaceous Plants are distinguished from *Anonaceæ* by their flowers being arranged upon a quinary, not ternary, type, by their albumen being solid, and not ruminated, and by their want of aromatic properties; from *Magnoliaceæ* by their want of stipules, and the presence of a pulpy aril round the seeds.

The plants of this order are chiefly Asiatic trees or shrubs, and usually yellow-flowered. A few occur in America. The trees are found in the woods of tropical India; the bushes inhabit Australia, especially in the more temperate parts, and in China; the woods of Brazil contain several kinds, usually climbers or having a trailing habit. They appear to possess astringent properties, but nothing further of importance.

The species in cultivation in this country are almost all Australasian, and have something the appearance of yellow-flowered *Cistuses*.

Among these occur species of the curious genus *Pleurandra*, in which the stamens are developed on one side only of the flower, all those on the opposite side being abortive. There are few analogies to this in the vegetable kingdom. *Hibbertia volubilis* is a showy twiner, but its flowers are intolerably offensive in their smell. The Indian species are in almost all cases plants of great beauty. They are remarkable both for the grandeur of their foliage and the magnificence of their flowers. Several species of *Dilleniaceæ* are large trees, and afford valuable timber.

1, a flowering shoot of *Hibbertia volubilis*; 2, the calyx and carpels, with one stamen only remaining; the other stamens cut away to show the carpels in the centre of the flower; 3, the ripe fruit.

DILUVIAL FORMATION. The superficial deposits of gravel, clay, and sand (sometimes containing shells and bones of land *Mammalia*), which lie far from their original sites on hills, and in other situations to which no forces of water now in action could transport them, are thus termed. The explanations proposed by geologists are various, and as yet unsatisfactorily demonstrated. Violent floods passing over the land; streams flowing formerly at levels and in lines now impossible; the littoral action of the sea during the time of the uplifting of the land; glacier movements; and the flotation of icebergs over the surface while yet it was covered by the ocean, have all been strongly proposed for adoption: but the phenomena are very complicated, and seem to require many partial solutions, involving change of level of sea and land as the fundamental condition. [ALLUVIUM.] (Lyell, *Principles of Geology*; Jukes, *Physical Geology*; De la Beche, *How to Observe in Geology*.)

DIMEROCRINITES, a genus of *Crinoidea*, proposed by Phillips ('Sil. System,' t. 17) to include species of *Crinoidea inarticulata* of Miller, with the finger-joints in double rows. From the Wenlock Limestone.

DIMORPHANTHUS, a genus of Plants belonging to the natural order *Araliaceæ*. One of the species, formerly *Aralia edulis*, is eaten in China. [ARALIACEÆ.]

DIMYARIA. [CONCHIFERA.]

DINEMOURA. [PŒCILOPODA.]

DINETUS, a genus of Hymenopterous Insects, of the section *Fossores*. [LARRIDÆ.]

DINGO, or *Australian Dog*. [CANIS.]

DINODES. [CHLÆNIUS.]

DINOPS. [CHEIROPTERA.]

DINORNIS, a genus of Birds probably extinct, the remains of several species of which have been found in New Zealand.

In November, 1839, Professor Owen exhibited, at a meeting of the Zoological Society of London, the fragment of the shaft of a femur, 6 inches in length, and 5½ inches in its smallest circumference, with both extremities broken off. This bone of an unknown struthious bird of large size, presumed to be extinct, was put into the Professor's hands for examination, by Mr. Rule, with the statement that it was found in New Zealand, where the natives have a tradition that it belonged to a bird of the eagle kind, which has become extinct, and to which they give the name Movie or Moa. Similar bones, it was said, were found buried on the banks of the rivers.

After a minute description of the bone, Professor Owen made the following statement:—"There is no bone of similar size which presents a cancellous structure so closely resembling that of the present bone, as does the femur of the ostrich; but this structure is interrupted in the ostrich at the middle of the shaft, where the parietes of the medullary, or rather air-cavity, are smooth and unbroken. From this difference I conclude the struthious bird indicated by the present fragment to have been a heavier and more sluggish species than the ostrich; its femur, and probably its whole leg, was shorter and thicker. It is only in the ostrich's femur that I have observed superficial reticulate impressions similar to those on the fragment in question. The ostrich's femur is subcompressed, while the present is cylindrical, approaching in this respect nearer to the femur of the emeu; but its diameter is one-third greater than that of the largest emeu's femur with which I have compared it. The bones of the extremities of the great *Testudo elephantopus* are solid throughout: those of the crocodile have no cancellous structure like the present bone. The cancellous structure of the mammiferous long bones is of a much finer and more fibrous character than in the fossil. Although I speak of the bone under this term, it must be observed that it does not present the characters of a true fossil; it is by no means mineralised; it has probably been on or in the ground for some time, but still retains most of its animal matter. It weighs 7 ounces 12 drachms avoirdupois.

"The discovery of a relic of a large struthious bird in New Zealand is one of peculiar interest, on account of the remarkable character of the existing Fauna of that island, which still includes one of the most extraordinary and anomalous genera of the struthious order; and because of the close analogy which the event indicated by the present relic offers to the extinction of the Dodo of the island of the Mauritius. So far as judgment can be formed of a single fragment, it seems probable that the extinct bird of New Zealand, if it prove to be extinct, presented proportions more nearly resembling those of the Dodo than of any of the existing *Struthionidæ*. Any opinion however as to its specific form can only be conjectural. The femur of the Stilt-Bird (*Himantopus*) would never have revealed the anomalous development of the other bones of the leg; but so far as my skill in interpreting an osseous fragment may be credited, I am willing to risk the reputation for it on the statement that there has existed, if there does not now exist, in New Zealand, a struthious bird nearly if not quite equal in size to the ostrich."

It was not long before an opportunity occurred of testing this very remarkable statement, and of proving the sagacity of the naturalist who had thus staked his reputation upon his conviction of the truth of the general principles of the science of comparative anatomy. Professor Owen received a communication from the Rev. W. Cotton describing several other remains of animals of the same kind, and in 1843 a collection, comprising vertebræ and bones of the hinder extremities, pelvis, &c., were transmitted by the Rev. W. Williams to the dean of Westminster (Dr. Buckland); and in 1846 many specimens were sent to England by Dr. Mackellar, Mr. Percy Earle, and Colonel Wakefield. These were placed in the hands of Professor Owen, and form the subject of his first and second 'Memoirs on the Dinornis,' in the 'Zoological Transactions,' vol. iii.

In these Memoirs Professor Owen pointed out that the bones which had been thus sent over from New Zealand contained the remains of no less than nine species of a remarkable group of birds, which he at first supposed belonged to the family of *Struthionidæ*. Subsequent examination however has led Professor Owen to the conviction that, although wingless, these birds have as little connection structurally and physiologically with the ostriches as with any other group of recent birds.

From an examination of the various bones thus collected, Professor Owen was enabled to point out that the fragment of bone which he had first received belonged to a species of the genus not only much larger than any of the other species indicated by these remains, but larger than any form of existing bird. To this species he gave the name of *Dinornis giganteus*, and found that the height of this bird must have been from 10 feet to 10 feet 6 inches. The other species described were—*D. ingens*, attaining a height of 9 feet; *D. struthioides*; *D. didiformis*, 4 feet; *D. dromæoides*, 5 feet; *D. struthioides* upwards of 6 feet. In addition to these were described—*D. curtus*, *D. crassus*, *D. otidiformis*, and *D. casuarinus*. Thus these remains showed the existence of a number of birds, varying in size from the almost flightless Bustard to birds of the size of the Dodo, the Emeu, and the Ostrich, and one larger than all.

On a subsequent examination of the bones of *D. ingens* and *D. dromæoides*, Professor Owen discovered a back toe which he had seen nowhere in the other species, and for these he proposed the generic name *Palapteryx*. To these two was afterwards added a third species, *P. geranoides*. Dr. Mantell gives the following account of a further discovery of the remains of birds in New Zealand:—

"In 1846 and 1847 my eldest son, Mr. Walter Mantell, of Wellington, who had resided several years in the colony, explored every known locality of these fossil bones within his reach in the North Island, and went into the interior of the country, and located with the natives, for the purpose of collecting specimens, and of ascertaining whether any of these gigantic birds were still in existence, resolving, if there appeared to be the least chance of success, to penetrate into the unfrequented regions, and obtain a live Moa. The information gathered from the natives offered no encouragement to follow up the pursuit, but tended to confirm the idea that this race of colossal bipeds was extinct, the last individuals having in all probability, like the Dodo, been exterminated by human agency within a comparatively recent period; or that if any of the species, whose bones occur in a fossil state, are still living, they will prove to be of comparatively small types, related to the *Apteryx*, the living diminutive representative of the stupendous ostrich-like birds which once trod the soil of New Zealand. My son succeeded however in forming the most interesting collection of these remains hitherto obtained. It comprised between 700 and 800 bones belonging to birds of various species and genera, and differing considerably in magnitude and age, some belonging to very young individuals, in which the epiphyses of the long bones are distinct from the shaft, while others are those of adult and aged birds." The chief part of this collection is now deposited in the British Museum.

The locality from which these specimens were obtained is thus described by Mr. Mantell:—"Near Waikoriati, 17 miles north of Otago, there is a headland called Island Point, about three-quarters of a mile in length and 150 feet in height; it consists of sandy clay distinctly stratified and traversed by dykes of columnar trap, the columns begin at right angles to the sides of the veins. In a little bight, south of Island Point, on the side of the bar which unites that headland to the mainland at the entrance of the River Waikoriati in front of the native Kaika, named Makuku, is situated the exposed parts of the so-called turbary deposit, whence bones of Moas and other birds of various kinds have been obtained in such number and perfection. This bed is about 3 feet in depth and not more than 100 yards in length, and lies immediately on a stratum of tertiary blue clay; its inland boundary is obscured by vegetation, and appears to be of a very limited extent; the bed is entirely submerged, and only visible when the tide has receded. It consists almost wholly of decayed vegetable matter, and its surface is studded with the undisturbed roots of small trees, which appear to have been burnt to the ground at some remote period. It is a light, sandy, elastic earth, of a blackish-brown colour, and emits a strong fetid odour when first collected; from the large quantity of animal matter it contains I conceive it was originally a swamp or morass, in which the New Zealand Flax (*Phormium tenax*) once grew luxuriantly. It is now covered by a thin layer of sand when exposed at low water. . . Although bones of several species of Moa, especially of the largest kinds, have been collected from this locality in considerable numbers and in great perfection, yet as the bed is rapidly diminishing from the inroads of the sea, there is great reason to fear that it will be entirely washed away, without yielding to the palæontologist all the desired information respecting the extinct animals whose relics it enshrines; for the natives and whalers are well aware of the interest attached to the bones by Europeans, and they seize indiscriminately on any specimen exposed by the receding tide, and if it cannot be readily extracted they break it off, and thus many a valuable relic has been destroyed. Their cupidity and avarice have too been so much excited by the large rewards injudiciously given by casual visiters, that the cost of specimens has increased to an unreasonable amount."

In their general aspect the bones which have been obtained from these spots closely resemble those obtained from the ossiferous caverns in Germany. Professor Owen gives an analysis of their chemical composition, and from this infers that they may have been recently deposited. Mr. Mantell obtained bones also from North Island:—"On the western shore of the North Island, about sixty miles south-west of New Plymouth, there is a stream called Waingougou, which empties itself into the sea at about a mile and a half south of Waimate in the Ngátirúanúi district. Part of the neighbouring country is elevated table-land, with deep tortuous gullies, through which the torrents and streams take their course to the sea. That of Waingougou, which is as tortuous as any of them, takes its rise in the neighbouring volcanic ridge, and has evidently at a former period discharged itself far distant from its present embouchure, as is proved by the existence of a line of cliffs which extends inland, and has manifestly been produced by the corroding action of the river. Driven from its course probably by a change in the relative level of the land and sea, the stream has formed its present channel, which cuts through a bed of loose conglomerate, 100 feet thick, overlying a deposit of finely-laminated sand, which covers a thick stratum of blue clay full of shells. The conglomerate consists of pebbles and large boulders of an infinite variety of volcanic rocks; the clay is the lowermost visible bed; the shells it contains are marine, and resemble species existing in the South Pacific Ocean; but I suspect many will be found specifically distinct from any recent forms. Between the two bluffs near the embouchure of the river there is a sand-flat about 200 yards across, and this on my first visit was strewn with bones of men, moas and other birds, and two species of seals. I had some deep openings made near the foot of the ancient cliff on the top of which is the Pa or native village of Ohawetokoloko, and at the same level as the flat on which I had observed the strewn fragments of bones I came to a regular ossiferous deposit. The bones however though perfect were as soft and plastic as putty, so that if grasped strongly they changed as it were by magic into pipe-clay; and it was necessary to dig them up with great care, and expose them to the air and sun to dry, before they could be packed and removed. . . Unfortunately the natives soon caught sight of my operations, and came down in swarms, men, women, and children, trampling on the bones I had carefully extracted and laid out to dry, and seizing upon every morsel exposed by the spade. My patience was tried to the utmost, and to avoid blows I was obliged to retreat and leave them in the possession of the field; and to work they went in right earnest, and quickly made sad havoc. No sooner was a bone perceived than a dozen natives pounced upon it, and began scratching away the sand, and smashed the specimen at once. It was with great trouble, and by watching the opportunity of working in the absence of the Maoris, that I procured anything worth having."

The remains thus procured by Mr. Mantell were placed at the disposal of Professor Owen by Dr. Gideon Mantell, who was thus enabled to supply many deficiences in his former descriptions of these remarkable birds. They afforded specimens of the bones of *Dinornis curtus*, *D. didiformis*, and *D. casuarinus*; also of *Palapteryx ingens*, variety *robustus*, and of a new species, *P. geranoides*. Notwithstanding the great number of bones that have thus been examined, one fragment only of the wings or humerus has been detected. This indicates the rudimentary condition of the wings in these birds. The humerus found Professor Owen regards as belonging to a species of *Palapteryx*. The following is a summary of the nature of this collection by Professor Owen:—"There are not less than 190 phalanges of the toes referrible to five or six species of *Dinornis*, *Palapteryx*, and *Notornis*, and there are 8 tarso-metatarsals, with the articular surface for a very strong hind toe, and of a conformation more nearly resembling those of the Dodo than of the *Dinornis* and *Palapteryx*, but shorter and thicker in proportion, and appertaining to the same bird as the tibia and fibula described in my Memoir of 1843 under the name of *D. otidiformis*. The proximal articulation of this remarkable form of tarso-metatarsal exactly fits the distal end of the tibia figured, and also that of a corresponding fractured tibia in Mr. Mantell's collection; which also contains the proximal end of another tibia, a fibula, an entire femur, and distal ends of two other femora, of the same species. The large surface for the hind toe; the strong calcaneal process forming a complete bony canal for the flexor tendons at the back part of the proximal end of the tarso-metatarsal; the perforation above the interspace between the outer and middle metatarsals for the tendon of the adductor muscle of the fourth toe, and the more posterior position of the condyle for the inner toe—all concur to indicate the generic distinction of the bird to which it belonged from either *Dinornis* or *Palapteryx*; and I propose to distinguish the new genus by the name of *Aptornis* and the present species *A. otidiformis*." ('Zool. Trans.' iii. p. 347.)

With the remains of the bones found on the banks of the river Waingougou were mixed the fragments of egg-shells. The eggs to which the fragments belonged were supposed to be about the size of a tea-cup. In connection with this subject the recent discovery of a large egg in Madagascar is interesting.

In a report to the French Academie de Sciences, M. Isidore Geoffroy St. Hillaire described three enormous fossil eggs from Madagascar, and some bones belonging to the same bird. The captain of a merchant-vessel trading to Madagascar one day observed a native using for a domestic purpose a vase which much resembled an egg, and upon examination proved to be one. The native stated that many such were to be found in the interior of the island, and eventually procured the eggs and bones exhibited by M. St. Hillaire. The largest of these eggs is equal in bulk to 135 hens' eggs, and will hold two gallons of water. M. St. Hillaire proposes the name of *Epiornis* for the monster biped of which these marvellous eggs and bones are the first evidence brought under the notice of naturalists. Casts of these eggs have been sent to this country, and are to be seen in various museums.

Amongst the bones sent home by Mr. Mantell, the remains of a new genus, *Notornis*, were found. It belongs to the same family as the *Brachypteryx* and the *Rallidæ*, and the interest that attaches to it in this relation is the fact that Mr. Mantell succeeded in obtaining a single living specimen. Many persons had reported the existence of a wingless bird as large as a fowl, and with red beak and legs, with a cry sounding like 'Keo Keo.' The following is Dr. Mantell's account of the discovery of this bird:—"On my son's second visit to the southern part of the Middle Island (as Government Commissioner for the settlement of native claims), he fell in with some sealers who had been pursuing their avocations along the little frequented islets and gullies of Dusky Bay on the south-western shores, and from them obtained the skin of a recent specimen of *Notornis Mantelli*. It appeared that when frequenting the coasts in search of seals and other game, these men observed on the snow, with which the ground was then thickly covered, the foot-tracks of a large and strange bird, and after following the trail for a considerable distance, they caught sight of the object of their search, which ran with great speed and for a long while distanced their dogs, but was at length driven up a gully in Resolution Island, and captured alive. It uttered loud screams, and fought and struggled violently; it was kept alive three or four days on board the schooner and then killed, and the body roasted and eaten by the crew, each partaking of the dainty, which was said to be delicious. The skin, with the skull and bones of the feet and legs, was preserved, and fortunately obtained by my son while in good condition, and thus perhaps the last of the race of Mohos was preserved for the naturalists of Europe. Upon comparing the head of the bird with the fossil crania and mandibles, my son was at once convinced of the specific identity of the recent and fossil specimens; and so delighted was he by the discovery of a living example of one of the supposed extinct contemporaries of the Moa, that he wrote to me and stated that the skull and beaks were alike in both, and that the abbreviated and feeble development of the bones and plumage of the wing were in perfect accordance with the indications afforded by the humerus and sternum found by him at Waingougou and now in the British Museum, as pointed out in the 'Zoological Transactions,' vol. iii. To the natives of the pahs, or villages, my son visited on his homeward route to Wellington, the *Notornis* was a perfect novelty, and excited great interest. No one had seen such a bird, but all agreed that it was the traditional Moho or Takahé, which they had believed was utterly extinct.

"This beautiful bird is about two feet high, and much resembles in its general form the *Porphyrio melanotus*, but it is larger and stouter, and generically distinct; the characters predicated by Professor Owen from the fossil remains being clearly marked in his recent volume. The beaks are short and strong, and as well as the legs were of a bright scarlet in the living animal. The neck and body are of a dark purple colour, the wings and back being shot with green and gold. The wings are short and rounded, and remarkably feeble both in structure and plumage. The tail is scanty and white beneath. The specific identity of the recent and fossil *Notornis* is confirmed by Mr. Gould, who has published a coloured figure the size of the original in a supplementary number of his splendid work on the 'Birds of Australia.'"

In addition to the bones of the animals mentioned, remains of other birds were found in the Mantellian collection. These were of a species of nocturnal Parrot, belonging to the genus *Nestor*, of a probably extinct species of *Apteryx*, of a species of Albatross allied to *Diomedea chlororhynchus*, and also of the Penguin.

For the structure of the *Apteryx* and its relations to other birds, see the article STRUTHIONIDÆ.

In 1851 Professor Owen received from Governor Grey a large collection of specimens from New Zealand of the bones, and more especially the skulls, of several of the species, which he described in a fifth memoir presented to the Zoological Society. An almost perfectly restored skeleton of the *Dinornis giganteus* exists in the Museum of the College of Surgeons. Professor Owen concludes one of the memoirs referred to with the following general remarks:—"The extraordinary number of wingless birds and the vast stature of some of the species peculiar to New Zealand, and which have finally become extinct in that small tract of dry land, suggest it to be the remnant of a larger tract or continent over which this singular Struthious Fauna formerly ranged. One might almost be disposed to regard New Zealand as one end of the mighty wave of the unstable and ever-shifting crust of the earth, of which the opposite end, after having been long submerged, has again risen with its accumulated deposits in North America, showing us in the Connecticut Sandstones of the Permian period the foot-prints of the gigantic birds which trod its surface before it sank; and to surmise that the intermediate body of the land-wave along which the *Dinornis* may have travelled to New Zealand has progressively subsided, and now lies beneath the Pacific Ocean."

(Owen, *Memoirs on the Dinornis*; *Zoological Transactions*, vol. iii.; Owen, *Proceedings of Zoological Society*, in *Annals of Natural History*; Mantell, *Petrifactions and their Teachings*.)

DINOTHE'RIUM, a genus of gigantic extinct Herbivorous Mammifers, established by Professor Kaup. The remains have been found most abundantly at Epplesheim in Hesse Darmstadt, in strata of sand referrible to the second period of the tertiary formations (Miocene of Lyell). Fragments are noticed as occurring also in several parts of France, Bavaria, and Austria, by Cuvier, who, from the resemblance of their molar teeth to those of the Tapirs, at first considered the animals to have been an enormous species of the last-named genus.

We select as an example *Dinotherium giganteum*, the largest species yet discovered, and which is calculated both by Cuvier and Kaup to have attained the length of 18 feet. The bones of the head and the teeth are the principal remains hitherto found. A scapula in form resembling more nearly that of a mole than any other animal, is the principal bone of the body yet found, and this shoulder-blade has been considered as indicating a peculiar adaptation of the fore leg to the purposes of digging. In the autumn of 1836, an entire head of the animal was disinterred at Epplesheim, measuring about 4 feet in length and 3 feet in breadth, of which Professor Kaup and Dr. Klipstein have given figures and a description. ('Beschreibung und Abbildungen von dem in Rheinhessen aufgefundenen colossalen Schedel des Dinotherii gigantei, mit geognostischen Mittheilungen über die knochenführenden Bildungen des mittelrheinischen Tertiärbeckens: von Dr. J. J. Kaup, & Dr. A. Klipstein. 4to., Darmstadt, 1836.')

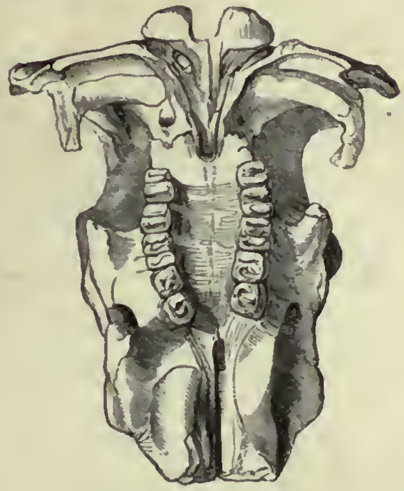
It will be seen from the cuts (which are copied from the works of Dr. Kaup and those of Drs. Kaup and Klipstein), as well as from the casts in the British Museum, that though the form of the molar teeth approximates to that of the tapirs, the tusks placed at the anterior extremity of the lower jaw and curved downwards somewhat after the fashion of those in the upper jaw of the Walrus, exhibit a remarkable deviation from this part of the dental formula in any other known animal, whether living or fossil. With this is combined a form of the lower jaw itself which cannot but arrest the attention of every observer.

Dr. Buckland, in the first edition of his 'Bridgewater Treatise,' published before the appearance of the memoir of Dr. Kaup and Dr. Klipstein, giving figures and a description of the entire head, but after the publication of Dr. Kaup's earlier publication,—when adverting to the *Mammalia* of the Miocene Period of Lyell, observes, that the second, or miocene system of tertiary deposits, contains an admixture of the extinct genera of Lacustrine *Mammalia*, of the first or Eocene series, with the earliest forms of genera which exist at the present time. This admixture, he adds, was first noticed by M. Desnoyers, in the marine formations of the Faluns of Touraine, where the remains of *Palæotherium*, *Anthracotherium*, and *Lophiodon*, which were the prevailing genera in the Eocene Period, are found mixed with bones of the Tapir, Mastodon, Rhinoceros, Hippopotamus, and Horse. These bones are fractured and rolled, and sometimes covered with *Flustræ*, thus giving indication of having been derived from carcasses drifted into an æstuary or sea. Similar admixtures, continues Dr. Buckland, have been found in Bavaria and near Darmstadt, and many of these animals also indicate a lacustrine or swampy condition of the regions they inhabited. One of them (*Dinotherium giganteum*) is stated to have attained 18 feet in length, and to have been the largest of all terrestrial *Mammalia* yet discovered, exceeding even the largest fossil elephant.

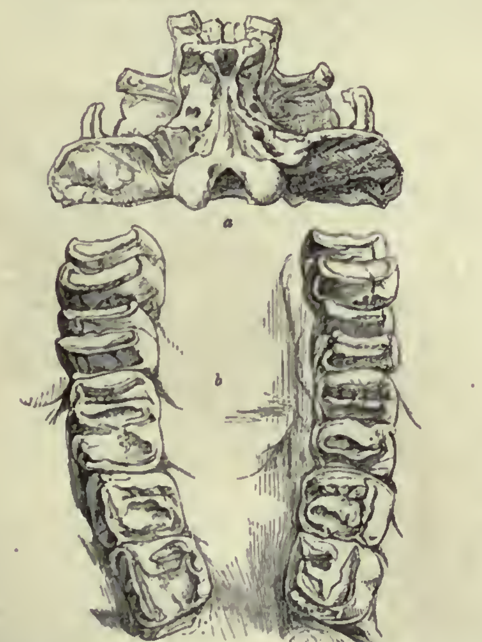
Profile of the skull of *Dinotherium giganteum*. The dotted line shows the edge of the coronoid process of left lower jaw, through the ramus of which the last molar tooth and a portion of the last but one are supposed to be seen. The zygomatic arch is fractured, and the intermediate portion of it lost.

Profile of lower jaw of *Dinotherium giganteum* (another individual), with the coronoid process gone, and only two teeth in sight. The length of this, including the tusk, is nearly four feet.

Skull of *Dinotherium giganteum*, seen from above.



Skull of the same, seen from below.



Portions of the skull of the same; *a*, posterior part of the skull, seen from below, showing the occipital condyle and foramen, &c.; *b*, roof of the mouth and molar teeth; the interval between the rows widening from before backwards.

In this view of the subject it becomes of importance to see what were the remains which were found in the strata of sand at Epplesheim, near Altzey, about 12 leagues south of Mayence, in company with those of the *Dinotherium*.

Dr. Kaup, in his 'Description d'Ossemens Fossiles' (Darmstadt, 1832), gives the following number of species:—*Dinotherium*, 2; *Tapirus*, 2; larger than living species. *Chalicotherium* (allied to Tapirs), 2; *Rhinoceros*, 2; *Tetracaulodon* (allied to Mastodon), 1; *Hippotherium* (allied to Horse), 1; *Sus*, 3; *Felis* (some as large as a Lion), 4; *Machairodus* (allied to Bear, *Ursus cultridens*); *Gulo* (Glutton), 1; *Agnotherium* (allied to Dog, but as large as a Lion), 1.

Dr. Buckland, in the work and in the edition above quoted, after giving a description of the tusks of the *Dinotherium*, thus proceeds:—"I shall confine my present remarks to this peculiarity in the position of the tusks, and endeavour to show how far these organs illustrate the habits of the extinct animals in which they are found. It is mechanically impossible that a lower jaw, nearly four feet long, loaded with such heavy tusks at its extremity, could have been otherwise than cumbrous and inconvenient to a quadruped living on dry land. No such disadvantage would have attended this structure in a large animal destined to live in water; and the aquatic habits of the family of Tapirs, to which the *Dinotherium* was most nearly allied, render it probable that, like them, it was an inhabitant of fresh-water lakes and rivers. To an animal of such habits, the weight of the tusks sustained in water would have been no source of inconvenience; and, if we suppose them to be employed as instruments for raking and grubbing up by the roots large aquatic vegetables from the bottom, they would, under such service, combine the mechanical powers of the pick-axe with those of the horse-harrow of modern husbandry. The weight of the head, placed above these downward tusks, would add to their efficiency for the service here supposed, as the power of the harrow is increased by loading it with weights. The tusks of the *Dinotherium* may also have been applied with mechanical advantage to hook on the head of the animal to the bank, with the nostrils sustained above the water, so as to breathe securely during sleep, whilst the body remained floating at perfect ease beneath the surface: the animal might thus repose, moored to the margin of a lake or river, without the slightest muscular exertion, the weight of the head and body tending to fix and keep the tusks fast anchored in the substance of the bank, as the weight of the body of a sleeping bird keeps the claws clasped firmly around its perch. These tusks might have been further used, like those in the upper jaw of the Walrus, to assist in dragging the body out of the water; and also as formidable instruments of defence. The structure of the scapula already noticed seems to show that the fore leg was adapted to co-operate with the tusks and teeth, in digging and separating large vegetables from the bottom. The great length attributed to the body would have been no way inconvenient to an animal living in the water, but attended with much mechanical disadvantage to so weighty a quadruped upon land. In all these characters of a gigantic, herbivorous, aquatic quadruped, we recognise adaptations to the lacustrine condition of the earth, during that portion of the tertiary periods to which the existence of these seemingly anomalous creatures appears to have been limited."

In his description of the figures of the remains of *Dinotherium* in the same work, Dr. Buckland observes that they were found in a sand-pit containing marine shells at Epplesheim, near Altzey, about 40 miles north-west of Darmstadt, where they are preserved in the museum. He adds, that bones of *Dinotherium* have lately been found in tertiary fresh-water limestone, near Orthes, at the foot of the Pyrenees; and with them remains of a new genus allied to rhinoceros; of several unknown species of deer; and of a dog or wolf, the size of a lion. The following conclusion terminates the note appended to the description in Dr. Buckland's first edition:—"From the near approximation of this animal to the living tapir, we may infer that it was furnished with a proboscis, by means of which it conveyed to its mouth the vegetables it raked from the bottom of lakes and rivers by its tusks and claws. The bifid ungual bone (Kaup, 'Add.,' table 11), discovered with the other remains of *Dinotherium*, having the remarkable bifurcation which is found in no living quadrupeds, except the Pangolins, seems to have borne a claw, like that of these animals, possessing peculiar advantages for the purpose of scraping and digging; and indicating functions concurrent with those of the tusks and scapulæ."

Upon referring to the view of the skull of *Dinotherium giganteum* seen from above, the width of the anterior portion of the cranium and the deep depression there visible, will strike the observer as very remarkable; and we find that Professor Kaup has, in his restoration of the animal, furnished it with a considerable proboscis, and given its general form as a good deal resembling that of the tapir.

Dr. Buckland, in the supplementary notes to his second edition, has the following notice, with a reference to p. 135:—"The *Dinotherium* has been spoken of as the largest of terrestrial *Mammalia*, and as presenting in its lower jaw and tusks a disposition of an extraordinary kind, adapted to the peculiar habits of a gigantic herbivorous aquatic quadruped." The Doctor then alludes to the entire head found in 1836, and thus proceeds:—"Professor Kaup and Dr. Klipstein have recently published a description and figures of this head, in which they state that the very remakable form and dispositions of the hinder part of the skull show it to have been connected with muscles of extraordinary power to give that kind of movement to the head which would admit of the peculiar action of the tusks in digging into and tearing up the earth. They further observe that my conjectures (p. 138) respecting the aquatic habits of this animal are confirmed by approximations in the form of the occipital bone to the occiput of *Cetacea;* the *Dinotherium,* in this structure, affording a new and important link between the *Cetacea* and the *Pachydermata.*" Dr. Buckland, in this second edition, gives a copy of the profile of the entire head and of the restoration.

Restoration of *Dinotherium giganteum.*

This head has been exhibited at Paris, and seems to have excited great interest among the French zoologists; for we find in the 'Journal des Débats' of the 21st of March in the year 1837 that at the sitting of the Académie Royale des Sciences de Paris on the day before M. de Blainville read a note detailing his particular views of the position which the animal held in the animal series—views which, it is there stated, were adopted both by M. Duméril and M. Isidore Geoffroy St. Hillaire. These views were detailed in 'L'Institut' of the 22nd of March; and the subject is so interesting that we here present them to the reader, more especially as they are so much at variance with the restoration, a copy of which is above given.

"M. de Blainville read a note on the fossil head of the *Dinotherium giganteum* recently exhibited at Paris by Messrs. Kaup and Klipstein. According to M. de Blainville the *Dinotherium* constituted a genus of mammifers of the family of the Dugongs and Lamantins, which family makes a part of the order or of the degree of organisation named by the last-mentioned zoologist *Gravigrades,* on account of their heavy progression, and of which the first family is formed by the Elephants. The following were the grounds stated for this opinion:—

"As regards the teeth, the molars, five in number on each side of each jaw, have their crown squared and deeply traversed by two transverse elevations, the same as in the Lamantins. But as this character occurs also in the Tapirs and Kangaroos, and even in the Laphiodons, it would be far from sufficient for deciding the question, if it were not joined with the absence of false molars and canines (a formula which produces a considerable space between the first molar and the incisors), and with the number and form of these last, which entirely resemble small tusks; only they are implanted at the extremity of the lower jaw and are directed downwards. Whether or no there existed a pair of incisors in the upper jaw is an uncertain point, the two extremities of this jaw which have been found being more or less truncated. It may however be inferred, from the enlarged and thick form of a fragment found some years ago, that it is possible that the animal might have had upper incisors, but smaller than those below: perhaps only rudimentary.

"As to the form of the head and its parts it corroborates what the dental system had established. In fact, the occipital condyles are entirely terminal, or in the direction of the longitudinal axis of the head, as in the Lamantins and the Cetaceous *Edentata,* modified for existence in the water. The occipital surface is large, subvertical, and even inclined from before backwards, with a profound mesial depression, for the insertion either of a very strong cervical ligament, or powerful muscles for the elevation of the head, and the basilary part of the skull is narrow in its component parts; while the syncipitofrontal region is on the contrary very flat, very wide, as in the lamantins and dugongs, overplumbing the temporal fossa, which is extremely wide and extremely deep, indicating enormous levator muscles for the lower jaw, not only for the purpose of mastication, but adapted besides for the particular action of that jaw with its rake-like incisor teeth. This disposition of the temporal fossa is perfectly in harmony with the zygomatic arch, which is wide, thick, robust, and complete, as far as may be inferred from the portion which is broken, but which nevertheless offers the articulating surface of the corresponding bone, exactly as in the lamantins; perhaps however without the great enlargement which may be remarked at the jugal apophysis of the temporal bone in the latter. The orbit is, as in the animals last named, very small and lateral, but very largely open in the zygomatic fossa. The auditory aperture is small, narrow, and rather oblique from below upwards. The face is wide and flattened, prolonged and enlarged a little, as in the *Cetacea,* anteriorly. It presents in its middle a very large aperture, the composition of which it has not been possible to study on account of the position of the head, which is upside-down, but which aperture, though evidently wider and greater than that of the dugong, has evidently the greatest analogy to what exists in that animal. The posterior orifice of the nasal cavity is on the contrary very narrow. The sub-orbital hole is very considerable, but even less perhaps than it is in the dugong. With regard to the lower jaw, that again exhibits the greatest analogy to that of the dugong, from the manner in which its branches are curved downwards towards the anterior third part of their length; only, that of the *Dinotherium* being armed at its recurved extremity with a tusk, the ascending ramus offers, in its width and its condyle, which is as transverse as in the *Carnivora,* a concordant disposition; so that the only motions permitted should be those of elevation and depression, as in those animals. The ethmoid surface of the temporal bone also is, as it were, a portion of a hollow transverse cylinder, with an apophysary lamina, having an extremely strong ridge—'une lame apophysaire d'arrêt extrêmement forte.' 'With this element (says M. de Blainville) we may regard it as nearly beyond doubt that the *Dinotherium* was an animal of the family of the Lamantins, or Aquatic *Gravigrades,* its proper position being at the head of the family, preceding the Dugong, and consequently preceded by the *Tetracaulodon,* which ought to terminate the family of the Elephants. In a word, the animal, in our opinion, was a Dugong with Tusk-Incisors. We must then suppose that it had only one pair of anterior limbs, with five toes on each. As to the supposition that the animal was provided with a trunk, which might be presumed from the great nasal opening, the enlarged surfaces which surround it, and the size of the suborbital nerve, as far as may be judged from the size of the suborbital hole, we believe that this is at least doubtful, and that it is more probable that these dispositions bear relation to a considerable development of the upper lip and the necessary modification of the nostrils in an aquatic animal, as is equally the case in the dugong. We think even that the upper lip by its immense development embraced the lower one, and thus hid even the base of the tusks, and that the lower one was sufficiently small, as may be presumed from the chin-holes (trous mentonniers). After this it is easy to perceive that of the two principal opinions which have been broached and discussed concerning this singular animal, we are much further from considering it a great species of *Edentata,* near the sloths, with Dr. Kaup, than from considering it as a tapir, as G. Cuvier did, from an examination of the molar teeth, the only parts then known. In fact, there is, in our opinion, much less distance, in the natural method, between a dugong and a tapir than between a dugong and a sloth.' In this note M. de Blainville has not taken into consideration that the head of the *Dinotherium,* as well as a phalanx which was found in the same locality, are referred by Professor Kaup to the same animal; but M. de Blainville does not believe that this phalanx really belonged to the *Dinotherium.* 'In fact (says he), Mr. Lartet found with these same phalanges a portion of a tooth, which evidently indicates a great pangolin.'

"At the end of the reading, M. Duméril rose to confirm the views of M. de Blainville. He insisted particularly on the transversal form and great extent of the condyle of the lower jaw and of the articular fossa destined to receive it. He much regretted the loss of the zygomatic arch, the bases of which only remain on the jugal and temporal bones. 'The curvatures of this arch,' said he, 'would have given ideas of the volume and force of the masseter and temporal muscles, which must have been considerable. It would be important to know them to compare them with those of the Lamantin on one side, and on the other with the *Megatherium,* whose skeleton is at Madrid. With regard to the phalanges, which are believed to be those of the *Dinotherium,* they are certainly analogous to those of the Sloths: but in the Lamantin, the ungual phalanx, which is in fact a double pulley with a mesial projection at the base, offers at its other extremity a single point with a sort of hood (capuchon) below: that is to say, inverse to that which is found in the great species of Cats (*Felis*), and very different from those of the Sloths and the Ant-Eaters.'"

In this statement there is one position that is rather staggering; and indeed we cannot but think it probable that M. de Blainville has not been quite accurately reported. He is made to observe that the articulation of the lower jaw is such that the only motions permitted should be those of elevation and depression, as in the *Carnivora.* Now, that with true grinding teeth, like those of the *Dinotherium,* the jaws should be limited to the motions of elevation and depression, so admirably fitted for working the cutting edges of the scissor-teeth of the *Carnivora,* is almost inconceivable. Without venturing to give any opinion as to the true position of this interesting genus in the animal series, we may be permitted to observe that the evidence on which M. de Blainville is stated to have rested for the cetaceous character of *Dinotherium*, appears to us to be rather meagre and hardly sufficient to warrant the conclusion. At present the extremities of this creature have not been found. They would undoubtedly throw more light on its true character than the skull alone can do. In the British Museum is the femur of an animal from Epplesheim, supposed to belong to the *Dinotherium*. If this point could be satisfactorily determined it would at once clear up the difficulty, and constitute the *Dinotherium* a terrestrial species.

DIODONTA. [TELLINIDÆ.]

DIŒCIA, the twenty-second class in the artificial method used by Linnæus in arranging plants. It comprehends such genera as have male or stamen-bearing flowers on one plant, and female or pistil-bearing flowers on another, as willows. Hence all plants having the sexes thus distinguished are called diœcious.

DIOMEDEINÆ, a family of Birds to which the Albatrosses belong. The characters of the genus *Diomedea* are given under ALBATROSS. In that article three species of this genus are referred to. We now give a complete list of the species of this important genus :—

Diomedea exulans, Linn. This bird is abundant between 30° and 60° S. lat., and equally numerous in all parts of the ocean bounded by those degrees; its range however extends much farther south, even to within the antarctic circle.

D. melanophrys, Temm. It is the most abundant species of the southern seas; equally numerous in every part between the 30th and 60th degrees.

D. cauta, Gould. This species was procured by Mr. Gould off the south coast of Van Diemen's Land.

D. chlororhynchos, Lath. It occurs between 30° and 60° S. lat., in both the Atlantic and Pacific Oceans.

D. culminata, Gould. This bird is rather abundant both in the Pacific and Atlantic Oceans, between 30° and 50° S. lat.

D. fuliginosa, Gmel. It occurs in all parts of the ocean between 30° and 60° S. lat.; equally common off Van Diemen's Land, Cape Horn, and the Cape of Good Hope.

D. brachyura, Temm. Found in the North Pacific Ocean.

D. gibbosa, Gould. An inhabitant of the North Pacific Ocean.

D. olivaceorhyncha, Gould. China seas (?).

Mr. Gray, in his 'Genera of Birds,' also gives *D. spadicea* as a species. He also makes *D. gibbosa* (Gould) synonymous with *D. nigripes*, Audubon, 'Orn. Biog.,' vol. v. p. 327, and adopts the latter name as having the priority.

DION. [CYCADACEÆ.]

DIONÆA, a most singular genus of herbaceous Plants belonging to the natural order *Droseraceæ*. There is one species, the *D. muscipula*, which is remarkable for the irritability of its leaves, which, when brushed against by an insect, will suddenly close upon it and hold it fast, whence it is often called Venus's Fly-Trap and the Carolina Catchfly Plant. It is botanically related to the *Drosera*, or Sundew, which has also the property of seizing insects by its viscid hairs, but differs so much as to have led some botanists to doubt whether it really belongs to the same natural order. Its flower-branches, for example, are not rolled up before they unfold, but have a straight æstivation; the placentæ of the fruit are stationed at the base of the one-celled capsule; the stigma is a lacerated fringed brush, and there are other differences; but upon the whole it is probably a genuine portion of the Droseraceous Order.

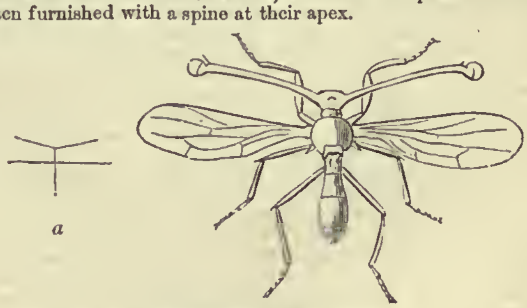
Dionæa has broad stalked leaves, spreading in a circle round the bottom of the flower-stem. Its flower-stem rises straight to the height of 6 or 8 inches, and is terminated by a cyme of small greenish-white flowers, each of which has a calyx of 5 sepals, 5 wedge-shaped notched petals, 10 hypogynous stamens, and an ovary shaped like some of the old German wine-bottles, round at the bottom, and tapering suddenly into a short neck or style. The best modern account of its habits has been given by Mr. M. A. Curtis, who thus speaks of it from his observations upon the plant in its native bogs:—"The *Dionæa muscipula* is found as far north as Newbern, North Carolina, and from the mouth of Cape Fear River to Fayetteville. It is stated moreover to grow along the lower branches of the Santee, in South Carolina; and it is not improbable that it inhabits the savannahs, more or less abundantly, from the latter place to Newbern. It is found in great plenty for many miles around Wilmington in every direction. The leaf, which is the only remarkable part, springs from the root, spreading upon the ground at a little elevation above it. It is composed of a broad stalk, like the leaf of an orange-tree, winged, and from 2 to 4 inches long, which at the end suddenly expands into a thick and somewhat rigid blade, the two sides of which are semicircular, about two-thirds of an inch across, and fringed round their edges with somewhat rigid ciliæ, or long hairs, like eye-lashes. The leaf indeed may be aptly compared to the two upper eyelids, joined at their bases. Each portion of the leaf is a little concave on the inner side, where are placed three delicate hair-like organs, in such an order that an insect can hardly traverse it without interfering with one of them, when the two sides suddenly collapse and inclose their prey, with a force surpassing an insect's attempts to escape. The fringe or hairs of the opposite sides interlace, like the fingers of the two hands clasped together. The sensitiveness resides only in these hair-like processes on the inside, as the leaf may be touched or pressed in any other part without sensible effects. The little prisoner is not crushed and suddenly destroyed, as is sometimes supposed; for I have often liberated captive flies and spiders, which sped away as fast as fear or joy could hasten them. At other times I have found them enveloped in a fluid of mucilaginous consistence, which seems to act as a solvent, the insects being more or less consumed by it. This circumstance has suggested the possibility of the insects being made subservient to the nourishment of the plant, through an apparatus of absorbent vessels in the leaves. But as I have not examined sufficiently to pronounce on the universality of this result, it will require further observation and experiment on the spot to ascertain its nature and importance.

"It is not to be supposed, however, that such food is necessary to the existence of the plant, though, like compost, it may increase its growth and vigour. But however obscure and uncertain may be the final purpose of such a singular organisation, if it were a problem to construct a plant with reference to entrapping insects, I cannot conceive of a form and organisation better adapted to secure that end than are found in the *Dionæa muscipula*. I therefore deem it no credulous inference that its leaves are constructed for that specific object, whether insects subserve the purpose of nourishment to the plant or not. It is no objection to this view that they are subject to blind accident, and sometimes close upon straws, as well as insects. It would be a curious vegetable indeed that had a faculty of distinguishing bodies, and recoiled at the touch of one, while it quietly submitted to violence from another. Such capricious sensitiveness is not a property of the vegetable kingdom. The spider's net is spread to ensnare flies, yet it catches whatever falls upon it; and the ant-lion is roused from his hiding-place by the fall of a pebble; so much are insects also subject to the blindness of accident."

We may add, with reference to the American author's conjecture that the trapped insects may contribute to the nourishment of the leaf of *Dionæa*, that leaves have actually been fed with chopped meat, and have been found to become more healthy and vigorous in consequence of this artificial stimulus; but still no argument can be drawn from this fact in favour of the supposition that the plant catches flies for nutriment, as most plants would be benefited by such treatment.

DIOPSIDE. [AUGITE.]

DIOPSIS, a genus of Dipterous Insects of the family *Sepsidæ*. The insects of this genus are remarkable for the immense prolongation of the sides of the head. The head itself is small, and appears as if it were furnished with two long horns, each having a knob at its apex; these horn-like processes however are not analogous to the parts usually termed antennæ, but are in fact prolongations of the sides of the head, the knob at the apex of each being the eye of the insect. They vary in length according to the species. In some they are almost equal to the whole length of the insect, whereas in others they are only about half that length. The antennæ are situated close to the eyes, and are three-jointed: the basal joint is the smallest and is very short; the terminal joint is the largest, of a globular form (or nearly so), and furnished towards the apex with a simple seta; there is also a short seta on the peduncle or eye-stalk, situated about midway between the base and the apex of that process, and on the anterior part. The thorax is somewhat attenuated anteriorly, but approaches to a spherical form, and is generally furnished with two spines on each side; the scutellum is also furnished with two spines. The body is more or less elongated, sometimes nearly cylindrical, but generally increases in diameter towards the apex. The legs are tolerably long—the anterior femora are generally thick, and furnished beneath with minute denticulations, and the four posterior femora are often furnished with a spine at their apex.



Diopsis Sykesii. G. R. Gray.
a denotes the natural size.

The illustration represents the *Diopsis Sykesii*, one of the largest species of the genus, and which has been selected as possessing the longest eye-stalks; these processes in this insect are of a pitchy red colour, and the body is of the same tint. The head and thorax are black, and the wings are clouded with brown.

But little is known of the habits of these insects. Colonel Sykes, who collected great numbers of the above species during his residence in India, furnished Mr. Westwood with the following notice respecting their habitat and habits:—

"Habitat.—The hill fort of Hurreechunderghur, in the western ghauts of the Deccan, at an elevation of 3900 feet above the level of the sea, 19° 23′ N. lat., 73° 40′ E. long.

"This insect affects chasms or ravines in the lofty woods which encircle the mountain in belts. In various places, where the sunbeams occasionally pierce the woods and fall upon isolated or salient rocks in the above localities, they are seen in myriads, either poising themselves in the rays, or reposing on the spots on which the rays fall."

All the known species are from the tropical parts of the Old World. (Westwood, *Transactions of Linnæan Society*.)

DIOPTASE, a Silicate of Copper. [COPPER.]

DIORITE, a rock consisting of Albite and Hornblende, also called *Greenstone*.

DIOSCO'REA, a genus of Plants which furnish the tropical esculents called Yams. It is the type of the natural order *Dioscoreaceæ*. The genus consists of perennial fleshy-rooted or tuberous diœcious plants, with annual twining stems, broad alternate leaves having a somewhat netted arrangement of their veins, and loose clusters of small green flowers. The corolla and the calyx taken together consist of 6 small equal segments, which, in the females, stand upon the top of the ovary. The male flowers have 6 stamens; the females 3 styles. The seed-vessel is a thin compressed 3-winged capsule, containing one or two membranous seeds.

The best account of the species is that of Dr. Roxburgh, who cultivated seventeen sorts in the Botanic Garden, Calcutta; others are known to botanists, but far from perfectly.

D. alata, the common West India Yam. It is a native of the West Indies, but is met with in the East Indies also, but only in a cultivated state. A figure of it is given in Rheede's 'Hortus Malabaricus,' vol. vii. t. 38, under the name of Katsji-kelengu. Its tubers are oblong, brown externally, white internally, and often of great size, weighing sometimes as much as 30 lbs.; they perish after the first year, if left in the ground, having first produced the young ones that are to replace them. "Besides the tubers the proper roots of all these plants are fibrous, springing from and chiefly about the union of the stems with the tubers, and spreading in every direction." The stems are furnished with four crested leafy wings, and spread to a great extent twining round trees and bushes; they often bear prickles near the ground. The first leaves that appear on the stem are alternate, the succeeding are opposite, seated on long stalks, deeply heart-shaped at the base, sharp-pointed, smooth, with from five to seven ribs. The flowers are small and green, and appear in compound panicles. The remainder of the species are very similar to this in general characters; a few short notes will sufficiently indicate their differences.

D. globosa, cultivated in Bengal under the name of Choo-Pureo-Aloo, is most esteemed of the Indian Yams. Its flowers are highly fragrant; the tubers are white internally; the leaves arrow-headed.

D. rubella, the Guranya-Aloo, is another Indian sort with large tubers stained with red immediately below the cuticle; it is much esteemed; its tubers are sometimes three feet long; its flowers are fragrant.

D. purpurea, called Lal-Guranya-Aloo in Bengal. The tubers are permanently stained purple throughout.

At Malacca is cultivated another purple-rooted sort, the *D. atropurpurea*, whose tubers are large and irregular, and grow so near the surface of the ground as to appear in dry weather through the cracks that they make in the soil by raising the earth over them.

Other eatable sorts are numerous, but are less valuable, and therefore not cultivated. In Otaheite the *D. bulbifera*, which bears small fleshy angular tubers along the stem in the axils of the leaves, is the favourite species.

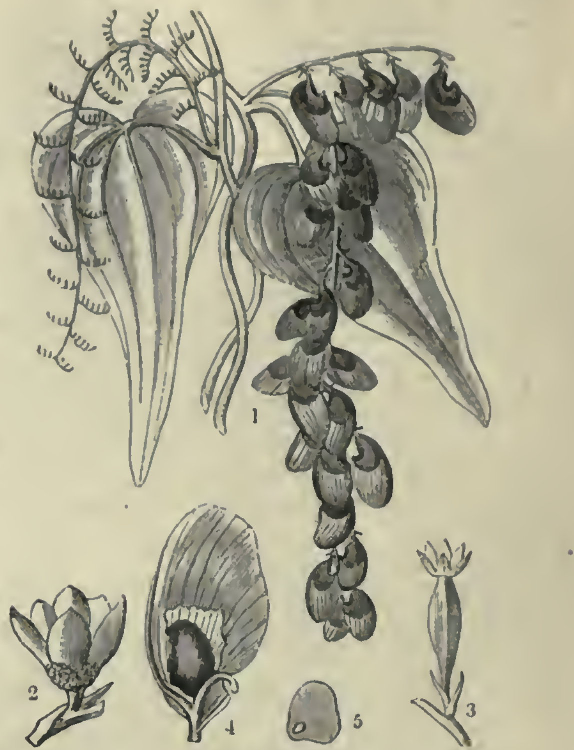
It is not a little remarkable that while so many species are nutritious in this genus, some should be highly dangerous; but such is unquestionably the fact. *D. Dæmonum* and *D. triphylla*, both ternate-leaved species, have very nauseous and dangerous tubers.

DIOSCOREA'CEÆ, *Yams*, the Yam Tribe, a natural order of Plants belonging to the class Dictyogens. They are particularly distinguished by the following characters:—

Flowers diœcious; calyx and corolla superior; stamens 6; ovary 3-celled, with 1 or 2-seeded cells; style deeply trifid; fruit leafy, compressed, occasionally succulent; embryo small, near the hilum, in a large cavity of cartilaginous albumen. The affinities of this order are with *Smilaceæ* and *Aristolochiaceæ*. It contains 6 genera and 100 species.

All the species are twining shrubs, with alternate or spuriously opposite leaves. They consist, with the exception of *Tamus*, Black Bryony, of tropical plants, or at least of such as require a mild frostless climate. Some of them produce eatable farinaceous tubers, or yams, as the various species of *Dioscorea* and *Testudinaria*; but there is a dangerous acrid principle prevalent among them, which renders the order upon the whole suspicious. It exists in a perceptible degree in *Tamus*, and is still more manifest in the 3-leaved *Dioscorea*. [TAMUS; TESTUDINARIA; DIOSCOREA; RAJANIA.]

DIOSMA, a genus of Rutaceous Shrubs inhabiting the Cape of Good Hope. They have alternate simple leaves, strongly marked with dots of transparent oil, and diffusing a powerful odour when bruised. Some of the species are offensive to the European taste, as



Dioscoreaceæ.

1, a shoot of *Rajania cordata*; 2, a male flower; 3, a female flower; 4, a portion of a ripe fruit with the seed exposed; 5, a section of the seed.

the Buckus with which the Hottentots perfume themselves, and which are chiefly yielded by *D. crenata* and *D. serratifolia*. The flowers of most are white; those of a few are red. By most modern botanists the old genus *Diosma* is broken up into eight, namely, *Adenandra*, *Coleonema*, *Diosma* proper, *Euchætis*, *Acmadenia*, *Baryosma*, to which the Buckus belong, *Agathosma*, and *Macrostylis*.

The following are the best known species of the old genus *Diosma*:—

D. serratifolia has linear lanceolate leaves, acuminate, serrulated, smooth, glandular at the edges, and 3-nerved. The flowers are lateral, white, upon short axillary bracteate peduncles. This species is an erect shrub, smooth in every part, and growing a foot or so high; branches tapering, purplish, long, lax; branchlets somewhat whorled, ternate or scattered, angular, purple, twiggy, incurved, loose. Leaves alternate on short stalks, ovate-oblong, blunt, flat, smooth, deep green above, paler beneath, dotted with sunken glands, the midrib somewhat keeled, the margin scolloped, glandular-dotted, and shining. Flowers solitary, white, middle sized. Peduncles filiform, shorter than the leaves.

D. crenulata is an upright shrub between two and three feet high, with twiggy branches of a brownish purple tinge. The leaves are decussate, spreading, about an inch long, oval-lanceolate, on very short petioles, very obtuse, delicately and minutely crenated, quite glabrous, rigid and quite smooth above; the peduncles about as long as the leaf, axillary, and terminal, chiefly from the superior leaves.

D. crenata (Linn.), *D. serratifolia* (Vent.), and *D. crenulata* yield leaves which at the Cape of Good Hope are termed Buchu, or Bucco, and which are sometimes used alone, but more frequently mixed. When bruised they emit a strong peculiar odour resembling rosemary or rue. The taste is aromatic, but not bitter or disagreeable.

Cadet de Gassecourt analysed the leaves, and found no alkaloid, but 6·65 of volatile oil; 21·17 extractive; 2·15 resin; 63 lignin; 1·10 chlorophylle. Brandes considers the extractive to be peculiar, and terms it Diosmin, analogous to Cathartin. The volatile oil and the extractive appear to be the active ingredients. They are usually administered in the form of infusion. [BUCHU, in ARTS AND SC. DIV.]

DIOSPYROS (from διὸς and πυρὸς, which may be translated 'celestial food'), a genus of Plants belonging to the natural order *Ebenaceæ*. They all form large trees, with alternate thick often coriaceous leaves. The flowers are usually single and axillary, the male and female flowers separate or united. Calyx and corolla 4-cleft, rarely 5-cleft. Stamina often 8, but varying in different species. Germ superior, often 8-celled; cells 1-seeded; attachment superior. Styles 3 or 4, rarely 5, or 1, and variously divided. Berry from 1- to 12-seeded, often 8-seeded. Embryo inverse, and furnished with albumen. Male flower frequently with twin anthers. The species are found chiefly in the tropical parts both of Asia and America, as in the Malayan Archipelago and Peninsula, and in almost every part of India. One species extends southward to Australia; one, *D. Lotus*, to Switzerland; and *D. Virginiana* into the United States of America. As some are remarkable for the wood which they afford, and others on account of their fruit, it is necessary only to notice a few of each, though the whole require the labours of a monographist.

D. Ebenus, the True Ebony, and that which is considered to be of the best quality, is a large tree, a native of Mauritius, Ceylon, and apparently also of Madagascar; for *D. lanceolata*, Poir., collected by Commerson in that island, is considered the same. The leaves are very smooth, short, petioled, alternate, bifarious, oblong in shape, the buds very hairy; male flowers sub-racemed, with about twenty anthers, the hermaphrodite solitary, octandrous. Large quantities of the ebony of this species have been sometimes imported into Europe.

Ebony is well known as a hard black-coloured wood brought from the hot parts of the world. The Greek name is ἔβενος, from which the Latin *Ebenus* and our word Ebony have been immediately derived. It is first mentioned by Ezekiel, xxvii. 15, but in the plural, hobnem, where the men of Dedan are described as bringing to Tyre horns of ivory and ebony. The Persian name, abnoos, is that by which it is commonly known all over India; it is probable therefore that the name, like the wood itself, had an eastern origin. From its hardness, durability, susceptibility of a fine polish, and colour, which has almost become another name for blackness, ebony has always been in high estimation, and in the present day is much used for mosaic work and ornamental inlayings, though cheaper woods dyed black are frequently substituted.

Herodotus (iii. 97) mentions ebony as part of the presents brought in considerable quantities to the king of Persia by the people of Ethiopia. Dioscorides describes two kinds—one Ethiopian, which was considered the best; and the other Indian, which was intermixed with whitish stripes and spotted; and hence commentators have disputed whether there were one or two kinds of ebony. But the fact is that several trees yield this kind of wood, and all belong to the genus *Diospyros*. Owing to the known geographical distribution of this genus, the ancients must have derived their ebony either from the peninsula of India and the island of Ceylon, or by the coasting trade from Madagascar; for no species of *Diospyros* has yet been discovered by botanists in the upper parts of Egypt or in Abyssinia, though it is not improbable that some may be found, as the climate is well suited to their existence.

D. Ebenaster. This is also a tree of considerable magnitude, a native of Ceylon, of which the leaves are coriaceous and smooth on both sides, and the buds smooth.

D. reticulata (*Tesselaria*, Poir.) is another elevated tree, a native of Mauritius, of which the heart-wood forms Ebony.

D. melanoxylon, described and figured by Rumph, iii., 'Corom. Plants,' 1 to 46, by Dr. Roxburgh, is the Ebony-Tree of the Coromandel coast. It is found on the mountains of that coast as well as of Malabar and in Ceylon. It grows to be very large, particularly the male tree, of which the wood is also most esteemed. The leaves, which are sub-opposite, oval, oblong, obtuse, and villous, are deciduous in the cold season, the new ones appearing with the flowers in April and May; as in other species, it is only the centre of large trees that is black and valuable, and this varies in quantity according to the age of the tree. The outside wood, which is white and soft, time and insects soon destroy, leaving the black untouched. The ripe fruit is eaten by the natives, though rather astringent, as is also the bark. *D. tomentosa* and *D. Roylei* are other Indian species which yield ebony.

Several species of the genus bear fruit, which, though clammy and sub-astringent, is eaten by the natives of the countries where the trees are indigenous. We need name only the most celebrated, as *D. lotus*, a native of Africa, and now common in the south of Europe, which bears a small yellow sweetish fruit about the size of a cherry, and which has by some been supposed to be the famous Lotus of the Lotophagi; but this is more likely to have been the Jujube, called by botanists *Zizyphus Lotus*.

D. Kaki is celebrated in China and Japan: specimens introduced into the Botanic Garden of Calcutta were found to be identical with others from Nepaul. The fruit is described by Dr. Roxburgh as being tolerably pleasant. It is esteemed in China, where it attains the size of an orange, and is frequently sent to Europe in a dried state, and called the Date-Plum of China, and also Keg-Fig of Japan.

D. discolor of the Philippine Islands also bears a fruit which is esteemed, and called Mabolo.

D. Virginiana, the Persimmon-Tree, is indigenous in North America, especially in the middle and southern parts of the United States, where it attains a height of 60 feet, but it does not flourish beyond 42° N. lat. The fruit while green is excessively astringent, but when ripe, and especially after it has been touched by the frost, it is sweet and palatable. The fleshy part separated from the seeds is made into cakes, which are dried and preserved. A kind of cider has also been made from this fruit, and a spirituous liquor distilled from its fermented infusion.

D. glutinosa also affords a fruit which, though edible, is far from palatable, but more valuable as an article of commerce. The tree is middle-sized, a native of the moist valleys amongst the mountains of the Circars, and all along the foot of the Himalayas to 30° N. lat. Sir William Jones first mentioned what is well known throughout Bengal, that the astringent viscid mucus of the fruit is used for paying the bottoms of boats. The unripe fruit contains a large proportion of tannin, and its infusion is employed to steep fishing-nets in to make them more durable.

DIOTIS (double-eared, from δίς, double, and οὖς, ὠτός, an ear), a genus of Plants belonging to the natural order *Compositæ*, the tribe *Senecionidæ*, and the section *Anthemideæ*. It has homogamous discoïdal heads; florets hermaphrodite, tubular, the tube compressed, with two auricles at the base; the receptacle convex with concave downy-topped scales; the involucre bell-shaped, imbricated; the fruit is compressed, and is crowned with the persistent auricled tube of the corolla.

D. maritima is the only British species. The whole plant is densely cottony and white; the stem is about a foot high, recumbent below, densely leafy and corymbose above; the leaves sessile, oblong, obtuse, flat, crenate, persistent; the heads in terminal corymbose tufts; the flowers are yellow. It is found on sandy sea-shores, but is a rare plant. *Diotis* is adopted by some botanists as the name of a genus of plants belonging to the *Chenopodiaceæ*, the *Axyris ceratoides* of Linnæus. It is a shrub of no great beauty, and is found wild in Siberia, and some parts of Austria. It thrives well in a light soil, and is easily increased by layers or cuttings under a hand-glass.

(Babington, *Manual*; Koch, *Flora Germanica*.)

DIOXYLITE, a native Sulphato-Carbonate of Lead. [LEAD.]

DIPHANITE. [PREHNITE.]

DIPHUCE'PHALA, a genus of Coleopterous Insects belonging to the *Lamellicornes*, section *Phyllophagi*.

This genus appears to be confined to Australia, and the species of which it is composed are distinguished from those of allied genera chiefly by their having the clypeus deeply emarginated; they are of an oblong form; the thorax is attenuated anteriorly, the elytra are somewhat depressed, and the abdomen is very convex. The antennæ are 8-jointed, and the club is composed of 3 joints; the anterior tibiæ are generally dentated externally; the anterior tarsi of the males have the four basal joints dilated, and furnished with a velvet-like substance beneath, and all the claws are bifid.

A rich golden-green appears to be the prevailing colour of these insects, and we understand that they are found on flowers.

D. sericea (Kirby) is nearly half an inch in length, of a golden-green hue, and has a silk-like gloss on the upper parts; the legs are red; the anterior tibiæ have an obtuse tooth-like process on the outer side, near the apex; the head and thorax are very thickly and delicately punctured; the elytra are covered with confluent punctures, which are arranged in longitudinal rows, and each elytron has two smooth elevated striæ; the under parts of the body are covered with white scale-like hairs. This is the largest species known; there are however many which are nearly equal to it in size.

(*Transactions of the Entomological Society of London*, vol. i.)

DIPHYDÆ. [ACALEPHÆ.]

DIPHYDES. [ACALEPHÆ.]

DIPHYES. [ACALEPHÆ.]

DIPHYLLIDIA. [INFEROBRANCHIATA.]

DIPHYSA. [ACALEPHÆ.]

DIPLACA'NTHUS, a genus of Fossil Placoid Fishes, from the Old Red-Sandstone of Scotland. Agassiz admits four species. (*Reports of British Association for* 1842.)

DIPLAZIUM, a genus of Ferns. The rhizomas of one species, *D. esculentum*, are eaten.

DIPLEU'RA, a genus of *Trilobites*, proposed by Green.

DIPLOCLUNUM, a genus of Plants belonging to the natural order *Begoniaceæ*.

DIPLOCTE'NIUM, a fossil genus of Lamelliferous Corals, allied to *Turbinolia*, from Mæstricht. [MADREPHYLLIÆA.]

DIPLODA'CTYLUS, a genus of Lizards established by Dr. J. E. Gray, and regarded by him as forming a new genus in the family of *Geckos*.

Generic Character.—Scales sub-conformable, minute, smooth; the abdominal scales rather large; the caudal scales annulate and larger; the labial scales moderate, distinct, the three anterior ones on each side much the largest; no gular scales. Tail cylindrical, ventricose. Toes 5, 5, simple, subequal, subcylindrical, the points subdilated, bifid beneath, with two oval oblique smooth fleshy discs; claws 5, 5, small, very retractile. No femoral pores. (Gray.)

This genus differs from *Phyllodactylus* of the same zoologist in having the under sides of the tips of the toes furnished with two rather large oblong tubercles, truncated at the tip, and forming two oval discs placed obliquely, one on each side of the claw, instead of having, as in *Phyllodactylus*, two membranaceous scales. The scales of *Diplodactylus* are moreover uniform, whilst in *Phyllodactylus* there is a row of larger scales, extending along the back.

D. vittatus, the Yellow-Crowned Diplodactyle. Brown, with a broad longitudinal dorsal fillet; limbs and tail margined with rows of yellow spots.

There are two rows of rather distant small spots on each side of the body; the spots become larger on the upper surface of the tail, and are scattered on the limbs. Length of head and body two inches; that of the tail an inch and a quarter. It is an inhabitant of Australia, whence it was brought to England by Mr. Cunningham.

The Yellow-Crowned Diplodactyle (*Diplodactylus vittatus.*)

The remaining species of this genus in the 'British Museum Catalogue' are—*D. ornatus*, *D. ocellatus*, a native of Australia, *D. marmoratus*, from Australia, *D. bilineatus*, and *D. lineatus*, Cape of Good Hope.

DI'PLODON, Spix's name for a genus of Fresh-Water Conchifers, *Naiades* of Lea. [NAÏADES.]

DIPLODONTA. [LUCINIDÆ.]

DI'PLODUS, a genus of Fossil Placoid Fishes, from the Coal Formation and Mountain Limestone. (Agassiz.)

DIPLOLEPIS, a genus of Insects proposed by Geoffroy for some of the species which produce Galls. [GALLS.]

DIPLOPTERA, a division of stinging Hymenopterous Insects, including the various species of Wasps, and distinguished by having the upper wings folded longitudinally when at rest.

DIPLO'PTERUS, a genus of Fossil Placoid Fishes, from the Old Red-Sandstone of Scotland, three species; and from the coal shale of Leeds, one species. (Agassiz, *Report to British Association*, 1842.)

DIPLOTAXIS (from διπλοῦς, double, and τάξις, an arrangement, on account of the double rows of seeds in each cell), a genus of Plants belonging to the natural order *Cruciferæ*, and the tribe *Brassiceæ*. It has a compressed pod and subconvex valves, with one straight nerve, and the seeds oval or oblong, in two rows. The species are herbaceous plants, natives of Europe and the temperate parts of Asia and Africa. There are two British species: *D. tenuifolia*, with a leafy branched glabrous stem, shrubby below; and *D. muralis*, with an herbaceous simple hispid stem. The former is a fetid plant with large yellow flowers, and grows on old walls, and is not an uncommon plant in England and Scotland; the latter is a rare plant. (Babington, *Manual*; Loudon, *Encyclopædia*.)

DIPPER. [MERULIDÆ.]

DIPSACA'CEÆ, *Teazleworts*, the Teazle Tribe, a small natural order of Exogenous Plants, with monopetalous flowers, nearly allied to *Compositæ*, from which it differs in the ovule being pendulous instead of erect, in the embryo being inverted, in the anthers being distinct, not syngenesious, and in the corolla having an imbricated, not valvate æstivation. In habit the species are similar to *Compositæ*, having their flowers constantly arranged in heads. It embraces 6 genera and about 150 species. None of the species are of any importance except the Fuller's Teazle (*Dipsacus Fullonum*), whose prickly flower-heads are extensively employed in carding wool. Many of the species have handsome flowers, especially the Scabioses, and are cultivated in the gardens of the curious. Purple and Starry Scabioses are common hardy annuals. [DIPSACUS; KNAUTIA; SCABIOSA.]

DIPSACUS, a genus of Plants, the type of the natural order *Dipsacaceæ*. It has the following characters:—The calyx is cup-shaped, the involucel forming a thickened margin to the ovary; the corolla 4-fid; the receptacle with spinous scales shorter than the involucre; the fruit with four sides and eight little depressions. The species are erect prickly or pilose biennial herbs. The leaves are opposite; the heads of flowers are terminal, and the corollas lilac-coloured, yellow, or white.

D. sylvestris, the Wild Teazle, has opposite undivided leaves; the scales of the receptacle straight, at the end longer than the flowers, involucre curved upwards; the stem is five or six feet high, prickly, leafy, branched. It is a native of Great Britain, and common in hedges and by road-sides. The water which collects in the connated leaves has a reputation for curing warts, and also as a cosmetic amongst the country people; hence Ray conjectures it has one of its names, *Labrum Veneris*.

D. Fullonum, the Fuller's Teazle, has the scales of the receptacle hooked at the end as long as the flowers; involucres reflexed. This plant is extensively cultivated in Great Britain, especially in the north and west of England, on account of the use of its hard recurved spiny scales in the preparation of woollen cloth. In this way it has been probably introduced. The most useful kinds are grown on the continent of Europe, where it is an undoubted native. [TEAZLE, in ARTS AND SC. DIV.]

D. pilosus has the leaves stalked, with a leaflet at the base on each side. The heads of the flowers are small. It grows in moist shady places, and is a native of England and the whole of Europe.

There are many other species of *Dipsacus*, but they are of little importance.

A portion of the upper part of *Dipsacus Fullonum.*

1, a flower with the hard spiny bract from which it springs; 2, a corolla with two of the stamens, and the ovary containing a pendulous ovule much magnified; 3, a longitudinal section of a fruit, with the pendulous seed and the inverted embryo.

DIPSAS (Laurenti), *Bungarus* (Oppel), a genus of Serpents, placed by Cuvier under the great genus *Coluber*. Body compressed, much less than the head; scales of the spinal row of the back larger than the others.

D. Indica, Cuvier; *Coluber Bucephalus*, Shaw. Black, annulated with white.

The cut in the next page, from Guerin ('Iconog.') will illustrate the form.

The term *Dipsas* is also used by Dr. Leach to distinguish a genus of Fresh-Water Conchifers; and he states that its systematic situation is between *Unio* and *Anodonta* (Anodon); *Unio* of Sowerby; *Naïades* of Lea. [NAÏADES.]

DIPSASTRÆA. [MADREPHYLLIÆA.]

DI'PTERA, one of the orders into which Insects are divided. This name was first applied by Aristotle, and has subsequently been adopted by almost all entomologists to designate those insects the most striking characteristic of which is the possession of two wings only.

The common House-Fly and Blue-Bottle-Fly afford familiar examples of this order. Some Dipterous Insects however are destitute of wings (such as the species of the genera *Melophagus*, *Nycterobia*, &c.); hence it is necessary that we should here notice other peculiarities observable in these insects.

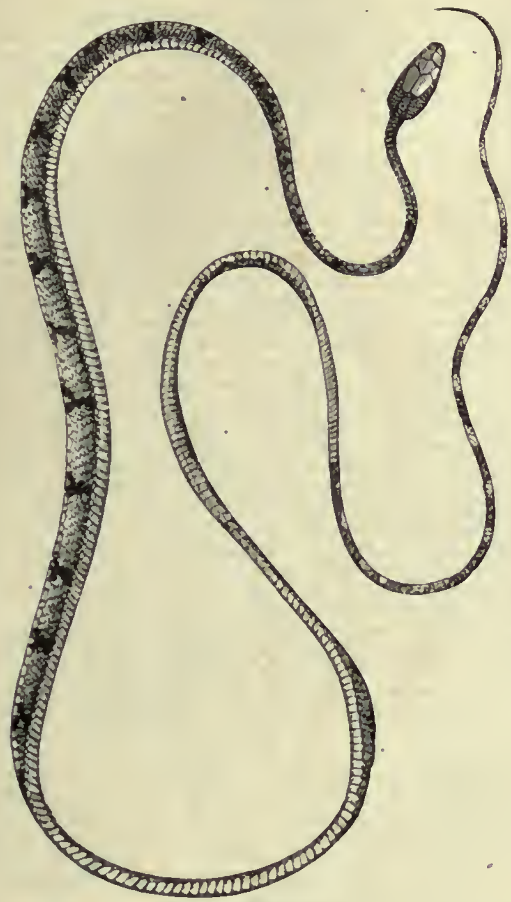
The *Diptera* have 6 legs furnished with 5-jointed tarsi, a proboscis, 2 palpi, 2 antennæ, 3 ocelli, and 2 halteres, or poisers.

The wings are generally horizontal in their position and transparent; their nervures are not very numerous, and are for the most part longitudinally disposed, a character in which the wings of Dipterous Insects differ from those of the orders *Neuroptera* and *Hymenoptera*.

The proboscis, situated on the under part of the head, is generally short and membranous, and consists of a sheath (or part analogous to the under lip or labium in mandibulate insects), which serves to keep in situ other parts of the mouth, which when they are all present represent the mandibles, maxillæ, tongue, and labium.

There are however considerable modifications in the structure of the proboscis: in some it is long, slender, and corneous; and the number of inclosed pieces, which are generally very slender and sharp, varies from two to six.

It is evident that this structure of mouth is adapted only to the



Dipsas cyanodon (Iconog.)

extraction and transmission of fluids; and when these fluids are contained within any moderately tough substance, the parts inclosed by tho sheath of the proboscis are used as lancets in wounding and penetrating so as to allow the escape of the fluid, which by their pressure is forced to ascend and enter the œsophagus.

The palpi are situated at the base of the proboscis. The antennæ are placed on the fore part of the head, and approximate at their base; they are generally small and 3-jointed; tho last joint however is often furnished with an appendage called the stylet, which is considerably diversified not only in form but in its position.

In some of the insects of this order, the *Tipulidæ* [TIPULIDÆ] for instance, the antennæ are long and composed of numerous joints; and iu tho *Culicides* [CULICIDES] they resemble little plumes.

The eyes in Dipterous Insects are generally large, especially in the male sex, where they often occupy nearly the whole of the head.

The Halteres, or Poisers, are two small organs of a slender form, and furnished with a knob at their apex, situated at the base of the thorax on each side, and immediately behind the attachment of the wings. Theso organs have been considered by many as analogous to the under wings of four-winged insects. Latreille and others however have come to a different opinion, from the circumstance of their not being attached to the same part of the thorax. The use of these organs is not yet ascertained; it is however supposed by some that tho little knob which we mentioned is capable of being inflated with air, and that they serve to balance the insect during flight, at which time these organs are observed to be in rapid motion.

As regards the thorax, it is only necessary here to observe that the chief part of that which is visible from above consists of the meso-thorax; the prothorax and metathorax being comparatively small.

The scutellum varies considerably iu form, and is sometimes armed with spines; we find it developed in an extraordinary manner in tho genus *Celyphus* (Dalman), where it is very convex, and covers the whole abdomen.

The abdomen seldom presents moro than seven distiuct segments; its form is very variable.

Dipterous Insects undergo what is termed a complete transformation. Their larvæ are devoid of feet, and have a head of the same soft substance as the body, and without determinate form. The parts of the mouth exhibit two scaly pointed plates. Tho stigmata are nearly all placed on tho terminal segment of the body. When about to assume the pupa state, they do not cast their skin (as is tho case with the larvæ of most insects), but this becomes gradually hardened, and after a time the animal assumes the pupa state within, so that the skin of the larva forms as it were a cocoon.

There are however exceptions to this rule, for many change their skin before they assume the pupa state, and some spin cocoons.

We may here observe, that in some of the species of the genus *Sarcophaga* the eggs are hatched within the body of the mother, whence the insect first makes its appearanco in the larva state; and in the *Pupipara* not ouly are the eggs hatched within the body of the pareut, but the larvæ continue to reside there until their transformation into pupæ.

As regards the habits of Dipterous Insects, they will be found under the heads of the several families and genera; we shall therefore conclude by noticing the two great sectious into which this order is divided by Macquart. These are the *Nemocera* and the *Brachocera*.

The species of these two sections are distinguished chiefly by the number of joints of the antennæ and palpi. Their characters are as follows:—

Section 1. *Nemocera.*—Antennæ filiform or setaceous, often as long as the head and thorax together, and composed of at least six joints; palpi composed of four or five joints; body generally slender and elongated; head small; proboscis sometimes long and sleuder, and inclosing six lancets; sometimes short and thick, haviug but two lancets; thorax large and very convex; legs loug; wings long, aud with elongated basal cells.

Section 2. *Brachocera.*—Antennæ short, composed of three joints, the third joint generally furnished with a stylet; palpi composed of one or two joints; head usually hemispherical, and as broad as tho thorax; proboscis either long, slender, coriaceous, and protruded, or short, thick, and retracted, aud containing either six, four, or two lancets; thorax moderately convex; legs usually of moderate length; wings with the basal cells rather short.

(Wiedemann, *Diptera Exotica*, 8vo, 1821; Meigen, *Systematische Beschreibung der bekannten Europäischen zweiflügelingen Insekten*, 6 vols. 8vo, with figures; Macquart, in the *Suites à Buffon, Histoire des Insectes*, 'Diptères,' 2 vols. 8vo.; Kirby and Spence, *Introduction to Entomology;* Walker, *British Museum Catalogue*, 'Diptera' in *Insecta Britannica.*)

DIPTERA'CEÆ, or DIPTEROCARPEÆ, *Dipterads*, an importaut order of East Iudiau Exogenous Polypetalous Trees. They have a tubular unequal permauent calyx, with five lobes, which after flowering become leafy and very much enlarged, surmounting the fruit without adhering to it. There are five petals, with a contorted æstivation, an indefinite uumber of awl-pointed narrow anthers, and a few-celled superior ovary, with two pendulous ovules in each cell; of these all

Dipterocarpus gracilis.

1, two of the stamens; 2, a ripe fruit surrounded by the calyx whose segments have become large and leafy, and very unequal.

are eventually abortive, except one, which forms the interior of a hard dry leathery pericarp. The seed is solitary, contains no albumen, and has an embryo with two large twisted and crumpled cotyledons, and a superior radicle. The leaves are long, broad, alternate, rolled inwards before they unfold, with strong straight veins running obliquely from the midrib to the margin, and oblong deciduous stipules rolled up like those of a *Magnolia*. The affinities of this order are with *Tiliaceæ* and *Corylaceæ* on the one side, and *Clusiaceæ* and *Ternstromiaceæ* on the other.

The different species produce a number of resinous, oily, and other substances; one a sort of camphor [DRYOBALANOPS]; another a fragrant resin used in temples; a third, Gum Animl; while some of the commonest pitches and varnishes of India are procured from others. Rhal, or Dhoona, a resin burned in the temples of India, is produced by *Shorea robusta*. Saul, the best timber in India, is furnished by the same tree. It contains 7 genera and 47 species. [DIPTEROCARPUS; DRYOBALANOPS; VATERIA.]

DIPTERIX. [COUMAROUNA.]

DIPTEROCARPUS, a genus of East Indian, and chiefly insular Trees, the type of the natural order *Dipteraceæ*. Blume gives the following essential characters:—"Calyx irregularly 5-lobed at the mouth; the two opposite segments very long and ligulate; petals five, convolute when unexpanded; stamens numerous; anthers long, linear, terminating in an awl-shaped point; nut rather woody, and 1-celled and 1-seeded by abortion, inclosed in the enlarged calyx." The species are described as enormous trees, abounding in resinous juice, with erect trunks, an ash-coloured bark, strong spreading limbs, and oval leathery entire leaves, with pinnated veins. The flowers are large, white or pink, and deliciously fragrant. The pubescence is always stellate when present. The resinous juice of *D. trinervis*, a tree from 150 to 200 feet high, inhabiting the forests of Java, is made into plaisters for ulcers and foul sores; and when dissolved in spirit of wine, or formed into an emulsion with white of egg, acts upon the mucous membranes in the same way as balsam of copaiva. *Dryobalanops Camphora*, the Camphor-Tree of Sumatra, is usually referred to this genus; but, according to Blume, is really a distinct genus. [DRYOBALANOPS.]

DI'PTERUS, a genus of Fossil Fishes, from the Old Red-Sandstone of Caithness and Herefordshire. (Valenciennes and Pentland, *Geol. Trans.*, 2nd series, vol. iii.)

DIPUS. [MURIDÆ.]

DIPYRE, a variety of Scapolite. It occurs with talc in the Pyrenees, and contains—

Silica	55·5
Alumina	24·8
Lime	9·6
Soda	9·4

It has a specific gravity of 2·65.

DIRCA, a genus of Plants belonging to the natural order *Thymeleaceæ*. It has a campanulate calyx, with an obsolete unequal limb; eight capillary projecting filaments inserted into the middle of the tube, alternately longer; the style incurved at the apex. This is an American genus, with a single species, the *D. palustris*. It is remarkable for growing in watery places, and is called Bois de Plomb by the French. It is found in the low woods of North America, bearing the severest cold, and the greatest heat of the various parts of the United States. It is an irregular shrub, with a tendency to a horizontal direction in its branches. The flowers are yellow, and appear before the leaves, and when young they are inclosed within a small hairy bud, occupying a sheath or cavity in the end of each flowering branch. The fruit is a small, oval, acute, red, 1-seeded berry. This plant is in all its parts very tough, and the twigs are used for making rods, the bark for ropes, baskets, &c. The bark is acrid, and in doses of six or eight grains it produces heat in the stomach, and brings on vomiting. It also acts as a vesicatory when applied to the skin, and in small doses as a cathartic. The fruit possesses narcotic properties, and produces effects upon the system similar to those of *Stramonium*. Snails are observed to be very fond of this plant, when it is cultivated. In its cultivation, layers require two years before they produce roots. It cannot be propagated in this country either by cuttings or seeds. (Loudon, *Encyclopædia of Plants*; Lindley, *Flora Medica*.)

DISA'STER, a subdivision of *Echinodermata*, including *Spatangus ovalis* of Phillips. From the Oolite. (Agassiz.)

DISCARIA, a genus of Plants belonging to the natural order *Rhamnaceæ*. One species, *D. febrifuga*, yields the Quina of Brazil, which is employed as a febrifuge and a tonic.

DISCO'BOLI, the third family of the Malacopterygious Osseous Fishes in the arrangement of Cuvier. The distinguishing character is the presence, on the under surface of the body, of a disc composed of the united ventral fins. The fishes of this family are popularly known as Sucking-Fishes. The most common and most remarkable species inhabiting the British seas is the Lump-Sucker (*Cyclopterus Lumpus*). It is a large-bodied small-finned fish, bearing on its back an elevated crest or ridge, and having a powerful sucker under its throat, formed of the combined pectorals and ventrals. Before the spawning season it is of a brilliant crimson colour mingled with orange, purple, and blue, but afterwards changes to a dull blue or lead colour. When full grown it is rough with tubercles, but when very young is smooth and beautiful, marked with brilliant stripes of various hues. In the seas of the Orkneys, in June, numbers of the young fish, half an inch in length, are seen swimming around floating sea-weeds. For a long time they were supposed to belong not only to a different species, but even to a different genus. In the old fish the sucker is so powerful that a pail of water, containing some gallons, has been lifted up by a person holding the tail of a *Cyclopterus* adhering to the bottom. It lives on young fish. It is brought to market, but oftener as a curiosity than as an article of food. The *Cyclopterus Lumpus* ranges from the shores of Greenland to those of the south of England, and westward as far as the coast of North America. Another genus of this family is *Lepadogaster*, consisting of a number of small fishes which have two discs on the under surface of their bodies, the one formed by the pectoral fins and the other by the ventrals. They adhere to stones, rocks, and shells by these discs. They have wedge-shaped defenceless bodies, smooth and without scales, often painted with the most brilliant and defined colours. The Sea-Snail, or *Liparis*, is a third genus of this family, the species of which resemble gobies in form. They are found under stones at low-water mark, and are not so brilliantly coloured as others of the tribe. They are furnished with a single sucker formed by the united ventrals and pectorals.

DISCOI'DEA, a genus of *Echinodermata*, in which are ranked, by Gray and Agassiz, several species generally referred to in works on organic remains under the title of *Galerites*. They belong to the Chalk, Greensand, and Oolite.

DISK, or DISC, a term in Botany signifying any ring or whorl of glands, scales, or other bodies that surround the base of an ovary, intervening between it and the stamens. In its most common state it is a fleshy wax-like ring as in the orange; it frequently forms a yellowish lining to the calyx, as in the plum and cherry; and not unfrequently rises up like a cup around the ovary, as in the tree pæony. The latter renders it probable that the disk is nothing but an inner whorl of rudimentary stamens. Previously to the expansion of the flower the disk contains fæcula, and is dry and brittle; but after the blossom unfolds, it perspires a sweet honey-like fluid, and becomes tough, absorbing oxygen and parting with carbonic acid.

DISSEPIMENTS, the partitions in the inside of a fruit which are formed by the union of the sides of its constituent carpels. Dissepiments are therefore necessarily alternate with the stigma. When partitions which do not bear this relation to the stigma occur in the inside of a fruit, they are called Phragmata, or spurious dissepiments, as in the *Cathartocarpus fistula*, where they are horizontal, and in *Verbena*, where they are vertical.

DISTHENE, a name for *Kyanite*. [KYANITE.]

DI'STICHOUS, a term in Botany, signifies 'arranged in two rows,' as the grains in an ear of barley, and the florets in a spikelet of quaking-grass.

DISTOMA. [BOTRYLLIDÆ.]

DITHYROCA'RIS, a fossil genus of Crustaceans, so named by Dr. Scouler. It occurs in Tyrone and Derry. *D. Colei* and *D. orbicularis* are described in Portlock's 'Geological Report' on those counties.

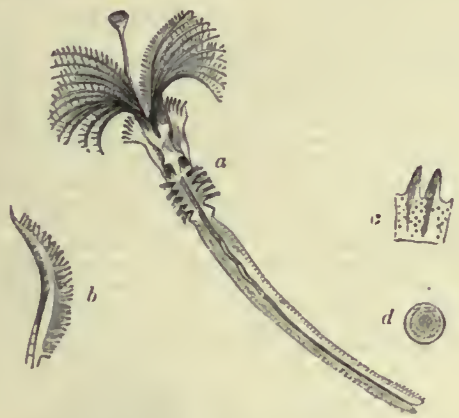
DITRU'PA, a genus of *Annelida*, founded by the Rev. M. J. Berkeley, and which, from its having been previously confounded with the species of an entirely distinct genus (*Dentalium*), and some circumstances respecting its capture in a living state, requires particular notice. It has the following characters:—

Shell free, tubular, open at both ends. Operculum fixed to a conical pedicellated cartilaginous body, thin, testaceous, concentrically striate. Branchiæ twenty-two, in two sets, not rolled up spirally, flat, broadest at the base, feathered with a single row of cilia. Mantle rounded behind, slightly crisped, denticulated in front, strongly puckered on either side. Fascicles of bristles, six on each side. (Berkeley.)

Mr. Berkeley states that a few of the specimens of sand, gravel, &c., from different parts of the great bank running parallel with the north-west coast of Ireland, obtained by Captain A. Vidal, R.N., during the extensive soundings made by that officer in the summer of 1830, whilst in search of Aitkin's Rock, were placed in his hands, when he found among them several specimens of the shell of a testaceous animal, which proved to be the *Dentalium subulatum* of Deshayes, and identical with the Madeira specimens; the only points of difference being a paler hue, and an almost total absence of the constriction near the orifice, the former being, as Mr. Berkeley observes, exactly such as might be expected from the occurrence of the species in a higher latitude, and the latter so variable as not to throw any doubt on its specific identity. Having previously been convinced, from Mr. Lowe's specimen, that the animal was not a *Dentalium*, but an Annelide, Mr. Berkeley requested Captain Vidal to preserve in spirit during the following summer, when operations on the bank were to be resumed, whatever animals he should procure alive in sounding, and, if possible, specimens of the so-called *Dentalium*, at the same time noting the depth at which they were taken. The result was the capture of the shell with the included animal, which enabled Mr. Berkeley to establish the genus named at the head of this article. The animals of the Madeira and British specimens proved to be perfectly identical.

It appears from Mr. Berkeley's paper, that the shells first handed to him by Captain Vidal occurred in fine sand, at various distances from the coast, in lat. 55°, at great depths—from 60 to 120 fathoms. After speaking of the animals preserved in spirit, and stating that Captain Vidal noted the depth at which each specimen was taken, Mr. Berkeley remarks that the so-called *Dentalium* did not occur at any less depth than 63½ fathoms, and twice (on one occasion off St. Kilda) it occurred at 171 fathoms. Nothing could be concluded as to habit, from the manner in which the shells were imbedded in the tallow (with which the lead was armed); but this was of the less consequence, says Mr. Berkeley, because it had appeared, from Mr. Lowe's information, that the animals are found in great numbers together, in masses of a conglomerate (if it may be so called) of mud and various marine substances, the broader end only appearing above the surface. Mr. Berkeley infers, from the great difference in the diameter, that the narrow or posterior end is gradually absorbed in the course of growth.

Mr. Berkeley is of opinion that, notwithstanding the resemblance of the shell to that of true *Dentalia*, it is most nearly allied to *Serpula;* but evidently distinct, in having an unattached shell (for there is no evidence to lead to a suspicion that it is attached, even in infancy), and especially in possessing a posterior as well as anterior aperture. He thinks that other species of so-called *Dentalia* may be found to belong to the genus *Ditrupa*. One at least, he observes, does so belong, namely, *Dentalium Gadus*, Mont. (*D. coarctatum*, Lam.). He thinks it highly probable that other minute British *Dentalia* will prove to possess an animal of like structure, though possibly, even in that case, it would be requisite to place them in a distinct genus.



Ditrupa subulata, magnified.

a, the animal; *b*, one of the branchiæ; *c*, a portion of the anterior part of the mantle; *d*, operculum. ('Zool. Journ.' vol. v.)

DITTANY OF CRETE, the common name of the woolly labiate Plant called *Origanum Dictamnus* or *Amaracus Dictamnus.*

DIURIS, a genus of curious Orchidaceous Plants, from Australia.

DIVERS. [COLYMBIDÆ.]

DIVI DIVI. [CÆSALPINIA.]

DIVI LADNER, the Forbidden Fruit of the Ceylonese. It is produced by a species of *Tabernæmontana.*

DOCK, the common name of many perennial tap-rooted species of the genus *Rumex.* They do not multiply by division of the root, but their seeds are dispersed in such abundance that they become a serious nuisance in cultivated land if they are not extirpated. The only two methods of doing this are either by tearing or digging them up, which is so slow as scarcely to be adopted in practical husbandry, or by constantly hoeing up their young shoots; by the latter means they usually may be destroyed in a single summer. [RUMEX.]

DOCLEA. [MAIADÆ.]

DODDER. [CUSCUTACEÆ.]

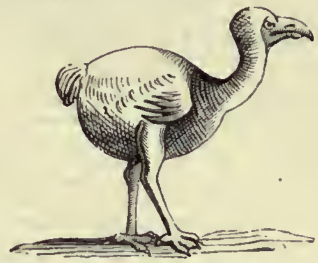
DODECAGY'NIA, the name of any order in the Linnæan classification of plants wherein the number of styles is twelve.

DODECA'NDRIA, the twelfth class in the Linnæan classification of plants. It contains species having twelve or about twelve stamens, provided they do not adhere by their filaments.

DODO (*Didus*), a genus of extinct Birds, of whose existence in the 16th and 17th centuries there is abundant evidence. As this is one of the few instances in which any history has been left of the extinction of a race of animals, we proceed to draw attention to the more prominent facts.

It appears that Vasco do Gama, after having doubled the Cape of Good Hope (Cabo Tormentoso, or Capo of Storms) in 1497, discovered at 60 leagues beyond it a bay, Angra de San Blaz, near an isle, where he saw a very great number of birds of the form of a goose, but with wings like those of the bats, which the sailors called Solitaries. On their return in 1499, the Portuguese touched again at San Blaz, where they took a great number of these birds, and comparing them to swans, called the island Ilha des Cisnes (Isle of Swans). In the voyage to the East Indies in 1598 by Jacob van Neck and Wybrand van Warwijk (small 4to., Amsterdam, 1648), there is a description of the Walgh-Vögels in the island of Cerne, now called Mauritius, as being as large as our swans, with large heads, and a kind of hood thereon; no wings, but in place of them three or four black little pens (pennekens), and their tails consisting of four or five curled plumelets (pluymkens) of a grayish colour. The breast is spoken of as very good, but it is stated that the voyagers preferred some turtle-doves that they found there. The bird appears with a tortoise near it in a small engraving, one of six which form the prefixed plate.

In the frontispiece to De Bry ('Quinta Pars Indiæ Orientalis,' &c., M.DCI), surmounting the architectural design of the title-page, will be found, we believe, the earliest engravings of the Dodo. A pair of these birds stand on the cornice on each side, and the following cut is taken from the figure on the left hand.



Dodo (*Gallus gallinaceus peregrinus.*)

In De Bry's 'Descriptio Insulæ de Cerne a nobis Mauritius dicta' is the following account:—"Cærulean parrots also are there in great numbers, as well as other birds; besides which there is another larger kind, greater than our swans, with vast heads, and one half covered with a skin, as it were, hooded. These birds are without wings, in the place of which are three or four rather black feathers (quarum loco tres quatuorve pennæ nigriores prodeunt). A few curved delicate ash-coloured feathers constitute the tail. These birds we called Walck-Vögel, because the longer they were cooked the more unfit for food they became (quod quo longius seu diutius elixarentur, plus lentescerent et esui ineptiores fierent). Their bellies and breasts were nevertheless of a pleasant flavour (saporis jucundi) and easy of mastication. Another cause for the appellation we gave them was the preferable abundance of turtle-doves which were of a far sweeter and more grateful flavour." It will be observed that the bill in De Bry's figure is comparatively small.

Clusius in his 'Exotica' (1605) gives a figure, here copied, which, he says, he takes from a rough sketch in a journal of a Dutch voyager who had seen the bird in a voyage to the Moluccas in the year 1598.

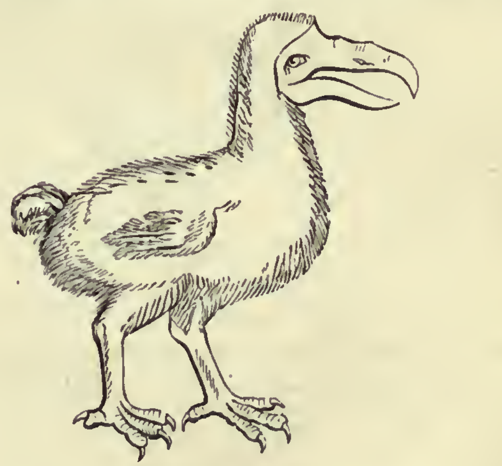


Figure from Clusius.

The following is Willughby's translation of Clusius, and the section is thus headed: "The Dodo, called by Clusius *Gallus gallinaceus peregrinus*, by Nieremberg *Cygnus cucullatus*, by Bontius *Dronte*":—"This exotic bird, found by the Hollanders in the island called Cygnæa or Cerne (that is the Swan Island) by the Portuguese, Mauritius Island by the Low Dutch, of 30 miles compass, famous especially for black ebony, did equal or exceed a swan in bigness, but was of a far different shape; for its head was great, covered as it were with a certain membrane resembling a hood: beside, its bill was not flat and broad, but thick and long; of a yellowish colour next the head, the point being black. The upper chap was hooked; in the nether had a bluish spot in the middle between the yellow and black part. They reported that it is covered with thin and short feathers, and wants wings, instead whereof it hath only four or five long black feathers; that the hinder part of the body is very fat and fleshy, wherein for the tail were four or five small curled feathers, twirled up together, of an ash-colour. Its legs are thick rather than long, whose upper part as far as the knee is covered with black feathers; the lower part together with the feet of a yellowish colour: its feet divided into four toes, three (and those the longer) standing forward, the fourth and shortest backward: all furnished with black claws. After I had composed and writ down the history of this bird with as much diligence and faithfulness as I could, I happened to see in the house of Peter Pauwius, primary professor of physic in the university of Leyden, a leg thereof cut off at the knee, lately brought over out of Mauritius his island. It was not very long, from the knee to the bending of the foot, being but little more than four inches, but of a great thickness, so that it was almost four inches in compass, and covered with thick-set scales, on the upper side broader, and of a yellowish colour, on the under (or backside of the leg) lesser and dusky. The upper side of the toes was also covered with broad scales, the under side wholly callous. The toes were short for so thick a leg: for the length of the greatest or middlemost toe to the nail did not much exceed two inches, that of the other toe next to it scarce came up to two inches: the back toe fell something short of an inch and a half; but the claws of all were thick, hard, black, less than an inch long; but that of the back toe longer than the rest, exceeding an inch.* The mariners in their dialect gave this bird the name Walgh-Vögel, that is, a nauseous or yellowish† bird; partly because after long boiling its flesh became not tender, but continued hard and of a difficult concoction, excepting the breast and gizzard, which they found to be of no bad relish, partly because they could easily get many turtle-doves, which were much more delicate and pleasant to the palate. Wherefore it was no wonder that in comparison of those they despised this, and said they could be well content without it. Moreover they said that they found certain stones in its gizzard, and no wonder, for all other birds as well as these swallow stones, to assist them in grinding their meat." Thus far Clusius.

In the 'Voyage of Jacob Heemskerk and Wolfert Harmansz to the East Indies' in 1601, 1602, 1603 (small 4to., Amsterdam, 1648), folio 19, the Dod-aarsen (Dodos) are enumerated among the birds of the Island of 'Cerne, now Mauritius;' and in the 'Journal of the East Indian Voyage of Willem Ysbrantsz Bontekoe van Hoorn, comprising many wonderful and perilous things that happened to him'—from 1618 to 1625 (small 4to., Utrecht, 1649)—under the head of the 'Island of Mauritius or Maskarinas,' mention is made (page 6) of the Dod-eersen, which had small wings, but could not fly, and were so fat that they scarcely could go.

Herbert, in his 'Travels' (1634), gives a figure or rather figures of a bird that he calls 'Dodo,' and the following account:—"The Dodo

Herbert's figure.

comes first to our description, here, and in Dygarrois (and no where else, that ever I could see or heare of, is generated the Dodo). (A Portuguize name it is, and has reference to her simplenes), a bird which for shape and rarenesse might be called a Phœnix (wer't in Arabia); her body is round and extreame fat, her slow pace begets that corpulencie; few of them weigh lesse than fifty pound: better to the eye than the stomack: greasie appetites may perhaps commend them, but to the indifferently curious nourishment, but prove offensive. Let's take her picture: her visage darts forth melancholy, as sensible of nature's injurie in framing so great and massie a body to be directed by such small and complementall wings, as are unable to hoise her from the ground, serving only to prove her a bird; which otherwise might be doubted of: her head is variously drest, the one halfe hooded with downy blackish feathers; the other perfectly naked; of a whitish hue, as if a transparent lawne had covered it: her bill is very howked and bends downwards, the thrill or breathing place is in the midst of it: from which part to the end, the colour is a light greene mixt with a pale yellow; her eyes be round and small, and bright as diamonds; her cloathing is of finest downe, such as you see in goslins; her trayne is (like a China beard) of three or foure short feathers; her legs thick, and black, and strong; her tallons or pounces sharp; her stomack fiery hot, so as stones and iron are easily digested in it; in that and shape, not a little resembling the Africk oestriches; but so much, as for their more certain difference I dare to give thee (with two others) her representation."—(4th ed., 1677.)

Nieremberg's description (1655) may be considered a copy of that of Clusius, and indeed his whole work is a mere compilation. As we have seen above, he names the bird *Cygnus cucullatus*.

In Tradescant's Catalogue ('Musæum Tradescantianum; or, a Collection of Rarities preserved at South Lambeth, near London, by John Tradescant,' London, 1656, 12mo.), we find among the 'Whole Birds'—"Dodar, from the island Mauritius; it is not able to flie being so big." That this was a Dodo there can be no doubt; for we have the testimony of an eye-witness, whose ornithological competency cannot be doubted, in the affirmative. Willughby at the end of his section on 'The Dodo,' and immediately beneath his translation of Bontius, has the following words:—"We have seen this bird dried, or its skin stuffed in Tradescant's cabinet." We shall hereafter trace this specimen to Oxford.

Jonston (1657) repeats the figure of Clusius, and refers to his description and that of Herbert.

Bontius, edited by Piso (1658), writes as follows: "De Dronte, aliis Dod-aers." After stating that among the islands of the East Indies is that which is called Cerne by some, but Mauritius 'a nostratibus,' especially celebrated for its ebony, and that in the said island a bird 'miræ conformationis' called Dronte abounds, he proceeds to tell us—we take Willugbby's translation—that it is "for bigness of mean size between an ostrich and a turkey, from which it partly differs in shape and partly agrees with them, especially with the African ostriches, if you consider the rump, quills, and feathers: so that it was like a pigmy among them, if you regard the shortness of its legs. It hath a great ill-favoured head, covered with a kind of membrane resembling a hood; great black eyes; a bending, prominent fat neck; an extraordinary long, strong, bluish-white bill, only the ends of each mandible are of a different colour, that of the upper black, that of the nether yellowish, both sharp-pointed and crooked.

Dronte. Figure from Bontius (wood-cut).
There is also a figure of the bird in the frontispiece, a copper-plate engraving.

It gapes huge wide as being naturally very voracious. Its body is fat, round, covered with soft gray feathers, after the manner of an ostriches: in each side instead of hard wing-feathers or quills, it is furnished with small soft-feathered wings, of a yellowish-ash colour; and behind, the rump, instead of a tail, is adorned with five small curled feathers of the same colour. It hath yellow legs, thick, but very short; four toes in each foot, solid, long, as it were scaly, armed with strong black claws. It is a slow-paced and stupid bird, and which easily becomes a prey to the fowlers. The flesh, especially of the breast, is fat, esculent, and so copious, that three or four Dodos will sometimes suffice to fill an hundred seamen's bellies. If they be old, or not well boiled, they are of difficult concoction, and are salted and stored up for provision of victual. There are found in

* We are indebted to Dr. J. E. Gray for the following measurement of the foot in the British Museum:—Knee to ancle 4½ inches; circumference 4 inches; middle toe 3 inches; back toe 1½ inch; front claws, which are much worn, 8 lines; back claw, also much worn, shorter. Dr. Gray observes that the leg mentioned by Clusius is probably, from the similarity of the measurement, the specimen which was afterwards noticed by Grew, and finally came to the British Museum.

† So in Willughby, but the print is somewhat indistinct, and there may be error. In the original the words are "Walgh-Vogel, hoc est, nauseam movens avis, partim quod," &c.: the word therefore is an interpolation.

their stomachs stones of an ash colour, of divers figures and magnitudes; yet not bred there, as the common people and seamen fancy, but swallowed by the bird; as though by this mark also nature would manifest that these fowl are of the ostrich kind, in that they swallow any hard things, though they do not digest them."

It appears from Adam Olearius ('Die Gottorfische Kunst Kammer,' 1666), that there was a head to be seen in the Gottorf Museum; but the figure (tab. xiii. f. 5) is very like that of Clusius. It is mentioned as the head of the Walch-Vogel, and Clusius is referred to. In the plate the head is shaded, and has a more finished appearance; the rest of the bird is in outline.

Grew ('Musæum Regalis Societatis; or a Catalogue and Description of the Natural and Artificial Rarities belonging to the Royal Society,' London, folio, 1681), at p. 68, thus describes the bird which is the subject of our inquiry:—"The leg of a Dodo, called *Cygnus cucullatus* by Nicrembergius; by Clusius, *Gallus gallinaceus peregrinus;* by Bontius called *Dronte*, who saith that by some it is called (in Dutch) Dod-aers, largely described in Mr. Willughby's 'Ornithol.' out of Clusius and others. He is more especially distinguished from other birds by the membranous hood on his head, the greatness and strength of his bill, the littleness of his wings, his bunchy tail, and the shortness of his legs. Abating his head and legs, he seems to be much like an ostrich, to which also he comes near as to the bigness of his body. He breeds in Mauris's Island. The leg here preserved is covered with a reddish-yellow scale; not much above four inches long, yet above five inches in thickness, or round about the joints, wherein, though it be inferior to that of an Ostrich or Cassowary, yet, joined with its shortness, may render it of almost equal strength." At p. 73 there is the following notice:—"The head of the Man of War, called also Albitrosse; supposed by some to be the head of a Dodo, but it seems doubtful. That there is a bird called the Man of War is commonly known to our seamen; and several of them who have seen the head here preserved do affirm it to be the head of that bird, which they describe to be a very great one, the wings whereof are eight feet over. And Ligon ('Hist. of Barbad.' p. 61), speaking of him, saith, that he will commonly fly out to sea to see what ships are coming to land, and so return. Whereas the Dodo is hardly a volatile bird, having little or no wings, except such as those of the Cassowary and the Ostrich. Besides, although the upper beak of this bill doth much resemble that of the Dodo, yet the nether is of a quite different shape; so that this either is not the head of a Dodo, or else we have nowhere a true figure of it." Grew then gives a very lengthened description of the skull which is figured by him (tab. 6), and intituled "Head of the Albitros," as it doubtless was. The leg above mentioned is that now preserved in the British Museum, where it was deposited with the other specimens described by Grew, when the Royal Society gave their 'rarities' to that national establishment. Grew was a well-qualified observer, and much of this description implies observation and comparison; indeed, though he does not refer to it, there is no reason for supposing that Grew was not familiar with Tradescaut's specimen.

Charleton also ('Onomasticon,' 1688) speaks of the *Dodo Lusitanorum*, *Cygnus cucullatus*, Willughby and Ray, and asserts that the Museum of the Royal Society of London contained a leg of the Dodo. This was evidently the leg above alluded to.

We now proceed to trace the specimen which was in the Musæum Tradescantianum. There were, it seems, three Tradescants—grandfather, father, and son. [TRADESCANT, in LIT. AND BIOG. DIV.] The two former are said to have been gardeners to Queen Elizabeth, and the latter to Charles I. There are two portraits to the 'Musæum,' one of 'Joannes Tradescantus pater' and the other of 'Joannes Tradescantus filius,' by Hollar. These two appear to have been the collectors: for John Tradescant, the son, writes in his address "to the ingenious reader" that he "was resolved to take a catalogue of those varieties and curiosities which my father had sceduloucly collected, and my selfe with continued diligence have augmented, and hitherto preserved together." This John Tradescant, the son, must have been the Tradescant with whom Elias Ashmole boarded for a summer when Ashmole agreed to purchase the collection, which was said to have been conveyed to Ashmole by deed of gift from Tradescant and his wife. Tradescant died soon after, and Ashmole in 1662 filed a bill in Chancery for a delivery of the curiosities. The cause is stated to have come to a hearing in 1664; and in 1674 Mrs. Tradescant delivered up the collection pursuant to a decree in Chancery, and afterwards (April, 1678, some say) was found drowned in her own pond. Ashmole added to the collection, and presented it to the University of Oxford, where it became the foundation of the Ashmolean Museum. That the entire 'Dodar' went to Oxford with the rest of Tradescant's curiosities there can be no doubt. Hyde ('Religionis Veterum Persarum, &c., Historia,' 1700) makes particular mention of it as existing in the Museum at Oxford. There, according to Mr. Duncan, it was destroyed in 1755 by order of the visitors, and he thus gives the evidence of its destruction:—

In the 'Ashmolean Catalogue, made by Ed. Llhwyd, Musæi Procustos,' 1684 (Plott being the keeper), the entry of the bird is "No. 29. Gallus gallinaceus peregrinus Clusii," &c. In a Catalogue made subsequently to 1755, it is stated that "The numbers from 5 to 46 being decayed, were ordered to be removed at a meeting of the majority of the visitors, Jan. 8, 1755." Among these of course was included the Dodo, its number being 29. This is further shown by a new Catalogue, completed in 1756, in which the order of the visitors is recorded as follows: "Illa quibus nullus in margine assignatur numerus a Musæo subducta sunt cimelia, annuentibus Vice-Cancellario aliisque Curatoribus ad ea lustranda convocatis, die Januarii 8vo., A.D. 1755." The Dodo is one of those which are here without the number. (Duncan, 'On the Dodo;' 'Zool. Journ.,' vol. iii. p. 559.)

Upon this solemn sentence, which left to the Museum nothing but a foot and a head, Sir C. Lyell makes the following observation: "Some have complained that inscriptions on tomb-stones convey no general information, except that individuals were born and died, accidents which must happen alike to all men. But the death of a species is so remarkable an event in natural history that it deserves commemoration; and it is with no small interest that we learn from the archives of the University of Oxford, the exact day and year, when the remains of the last specimen of the Dodo, which had been permitted to rot in the Ashmolean Museum, were cast away:" and the author concludes by giving the fatal record at length with becoming gravity. The head and foot which now constitute the greatest treasure of the Museum at Oxford were preserved by the curator, who seems to have had a larger amount of natural history knowledge than the majority of visitors.

We now come to the celebrated painting in the British Museum, a copy of which, by the kind assistance of the officers of the zoological department, who have given us every assistance in prosecuting this inquiry, and who had it taken down for the purpose, we present to our readers.

It has been stated that the painting came into the possession of Sir Hans Sloane, president of the Royal Society, and that it was bought at his sale by Edwards, who, after publishing a plate from it in his 'Gleanings,' presented it to the Royal Society, whence it passed, as well as the foot, into the British Museum. But Dr. Gray informs us that the foot only came with the museum of the Royal Society described by Grew; and that the picture was an especial gift from Edwards. Edwards's copy seems to have been made in 1760, and he himself says, "The original picture was drawn in Holland from the living bird brought from St. Maurice's Island in the East Indies in the early times of the discovery of the Indies by the way of the Cape of Good Hope. It was the property of the late Sir Hans Sloane to the time of his death; and afterwards becoming my property I deposited it in the British Museum as a great curiosity. The above history of the picture I had from Sir Hans Sloane and the late Dr. Mortimer, secretary to the Royal Society."

M. Morel, Ecrivain Principal des Hôpitaux au Port-Louis de l'Isle de France, writes as follows in his paper 'Sur les Oiseaux Monstrueux nommés Dronte, Dodo, Cygne Capuchonné, Solitaire, et Oiseau de Nazare, et sur la petite Isle de Sable à 50 lieues environ de Madagascar:' "These birds, so well described in the second volume of the 'History of Birds,' by M. le Comte de Buffon, and of which M. de Borame has also spoken in his 'Dictionary of Natural History,' under the names of Droute, Dodo, Hooded Swan (Cygne Capuchonné), Solitary or Wild Turkey (Dinde Sauvage) of Madagascar, have never been seen in the Isles of France, Bourbon, Rodriguez, or even the Seychelles lately discovered, during more than 60 years since when these places have been inhabited and visited by French colonists. The oldest inhabitants assure every one that these monstrous birds have been always unknown to them." After some remarks that the Portuguese and Dutch who first overran these islands may have seen some very large birds, such as Emeus or Cassowaries, &c., and described them each after his own manner of observing, M. Morel thus proceeds:—"However this may be, it is certain that for nearly an age (depuis près un siècle) no one has here seen an animal of this species. But it is very probable that before the islands were inhabited, people might have been able to find some species of very large birds, heavy and incapable of flight, and that the first mariners who sojourned there soon destroyed them from the facility with which they were caught. This was what made the Dutch sailors call the bird 'Oiseau de Dégoût' (Walck-Voegel), because they were surfeited with the flesh of it. . . . But among all the species of birds which are found on this isle of sand, and on all the other islets and rocks which are in the neighbourhood of the Isle of France, modern navigators have never found anything approaching to the birds above named, and which may be referred to the number of species which may have existed, but which have been destroyed by the too great facility with which they are taken, and which are no longer found excepting upon islands or coasts entirely uninhabited. At Madagascar, where there are many species of birds unknown in these islands, none have been met with resembling the description above alluded to." ('Observations sur la Physique, pour l'An 1778,' tom. xii. p. 154. Notes.)

Mr. Duncan thus concludes his paper above alluded to:—"Having applied, through the medium of a friend, to C. Telfair, Esq., of Port Louis, in the Mauritius, a naturalist of great research, for any information he could furnish or procure relating to the former existence of the Dodo in that island, I obtained only the following partly negative statement:—

"'That there is a very general impression among the inhabitants that the Dodo did exist at Rodriguez, as well as in the Mauritius itself; but that the oldest inhabitants have never seen it, nor has the bird or any part of it been preserved in any museum or collection formed in those islands, although some distinguished amateurs in natural history have passed their lives on them, and formed extensive collections. And with regard to the supposed existence of the Dodo in Madagascar, although Mr. Telfair had not received, at the time of his writing to Europe, a reply to a letter on the subject which he had addressed to a gentleman resident on that island, yet he stated that he had not any great expectations from that quarter; as the Dodo was not mentioned in any of his voluminous manuscripts respecting that island, which contained the travels of persons who had traversed Madagascar in all directions, many of them having no other object in view than that of extending the bounds of natural history.'"

We close this part of the case with the evidence of one evidently well qualified to judge, and whose veracity there is no reason to doubt. If this evidence be, as we believe it to be, unimpeachable, it is clear, not only that the Dodo existed, but that it was publicly exhibited in London. The lacunæ in the print represent the spaces occasioned by a hole burnt in the manuscript.

In Sloane Manuscript (No. 1839, 5, p. 108, Brit. Mus.) is the following interesting account by L'Estrange, in his observations on Sir Thomas Browne's 'Vulgar Errors.' It is worthy of note that the paragraph immediately follows one on the 'Estridge' (Ostrich):—

"About 1638, as I walked London streets I saw the picture of a strange fowl hong out upon a cloth vas and myselfe with one or two more Gen. in company went in to see it. It was kept in a chamber, and was a great fowle somewhat bigger than the largest Turkey Cock and so legged and footed but stouter and thicker and of a more erect shape, coloured before like the breast of a yong Cock Fesan (pheasant), and on the back of dunn or deare coulour. The keeper called it a Dodo and in the ende of a chimney in the chamber there lay an heap of large pebble stones whereof hee gave it many in our sight, some as bigg as nutmegs, and the keeper told us shee eats them conducing to digestion, and though I remember not how farre the keeper was questioned therein yet I am confident that afterwards shee cast them all agayne." *

Since the foregoing history was recorded in the 'Penny Cyclopædia,' the late Mr. Hugh Edwin Strickland, whose early loss by a melancholy accident the world of science has to deplore, has published a work on the Dodo and its kindred, in which he has most diligently retraced the ground previously gone over by Mr. Broderip. With regard to the statement of L'Estrange, Mr. Strickland says:—"I have endeavoured to find some confirmation from contemporary authorities of this very interesting statement, but hitherto without success. The middle of the 17th century was most prolific in pamphlets, newspapers, broadsides, 'rows of dumpy quartos,' and literary 'rubbish mountains,' as Mr. Carlyle designates them; but the political storms of that period rendered men blind to the beauties and deaf to the harmonies of nature, and its literature is very barren in physical research."

In addition to the works quoted in which reference is made to the Dodo, Mr. Strickland gives the following:—

Cornelius Matelief, a Dutch admiral, arrived in the Mauritius in 1606, and in a journal published in Dutch, and translated into French, gives an account of the Dodo, which he calls Dod-aersen, or Drouten.

Dodo, from the picture in the British Museum.

In 1607 two ships, under the command of Van der Haagen, stayed some weeks in the Mauritius. A journal was published in Dutch of this voyage, and translated in the 'Recueil des Voyages de la Compagnie des Indes Orientales,' Rouen, 1725.

Admiral Peter Wilhelm Verhuffen touched at Mauritius in 1611, and in 1613 an account of this voyage was published at Frankfurt, entitled 'Eylffter Schiffart ander Theil,' &c., in which reference is made to the Dodo, and especially to the fact that it attacked its aggressors, and wounded them severely if they were not careful.

In a journal by Peter van der Broecke, in which allusion is made to a visit to the Mauritius in 1617, Mr. Strickland discovered the sketch of a Dodo, but found no reference to it in the letter-press.

In a work published by François Cauche at Paris in 1651, entitled 'Relations veritables et curieuses de l'Isle de Madagascar,' he describes birds called Oiseaux de Nazaret, which answer to the Dodo. He says they lay but one egg the size of a halfpenny roll. How he came to

* This curious statement is extracted in the modern edition of Sir Thomas Browne's works by Wilkins: published by Pickering.

call the Dodo by this name, and what the size of a halfpenny roll was in 1651 are difficulties.

There is a tract in the Ashmolean Museum of which there are two editions, the first without a date, the second printed in London 1665. It is a catalogue of rarities to be seen at 'the musique house at the west end of Paules,' by R. H. alias Forges, Gentleman. Here at p. 11 we find "A Dodo's Leg; it is a bird that cannot fly." This is probably the specimen that passed into the possession of the Royal Society, and was described by Grew.

The last of Mr. Strickland's additions is a manuscript, entitled 'A coppey of Mr. Benj. Harry's Journall when he was chief mate of the Shippe Berkley Castle, Captn. Wm. Talbot then Commander on a voyage to the Coste and Bay, 1679, which voyage they wintered at the Maurisshes.' He speaks of the "Dodos, whose flesh is very hard."

This seems to be the last notice of the Dodo. "That the destruction of the Dodos," says Mr. Strickland, "was completed by 1693 may be inferred from the narrative of Leguat, who in that year remained several months in Mauritius, and enumerates its animal productions at some length, but makes no mention whatever of Dodos."

M. de Blainville says that at a public dinner at the Mauritius in 1816 several persons were present from 70 to 90 years old, who had no knowledge of such a bird from recollection or tradition. Mr. J. V. Thompson also, who resided for some years in Mauritius and Madagascar previous to 1816, states that no more traces of the existence of the Dodo could then be found than of the truth of the tale of Paul and Virginia, although a very general idea prevailed as to the reality of both.

Since the publication of the 'Penny Cyclopædia' the pictorial evidence of the existence and characters of this bird has also increased. In the royal collection of the Hague is a painting by Roland Savery, which is regarded as one of that master's chef d'œuvres. It represents Orpheus charming the animal creation with his music, and among innumerable birds and beasts the clumsy Dodo is represented as spell-bound by the lyric bard. This bird was discovered in this picture by Professor Owen in 1838.

"Whilst at the Hague," writes the professor to Mr. Broderip, "in the summer of 1838, I was much struck with the minuteness and accuracy with which the exotic species of animals had been painted by Savery and Breughel in such subjects as Paradise, Orpheus charming the Beasts, &c., in which scope was allowed for grouping together a great variety of animals. Understanding that the celebrated menagerie of Prince Maurice had afforded the living models to these artists, I sat down one day before Savery's Orpheus and the Beasts, to make a list of the species which the picture sufficiently evinced that the artist had had the opportunity to study alive. Judge of my surprise and pleasure in detecting in a dark corner of the picture (which is badly hung between two windows) the Dodo, beautifully finished, showing for example, though but three inches long, the auricular circle of feathers, the scutation of the tarsi, and the loose structure of the caudal plumes. In the number and proportions of the toes, and in general form, it accords with Edwards's oil painting in the British Museum; and I conclude that the miniature must have been copied from the study of a living bird, which it is most probable formed part of the Mauritian menagerie.

"The bird is standing in profile, with a lizard at its feet. Not any of the Dutch naturalists to whom I applied for information respecting the picture, the artist, and his subjects, seemed to be aware of the existence of this evidence of the Dodo in the Hague collection.

"I think I told you that my friend Professor Eschricht of Copenhagen had written to inform me that the skull of a Dodo had been lately discovered in the museum at Copenhagen: it had before formed part of the museum of the Duke of Gottorp."

In 1845 Mr. Strickland was examining Roland Savery's paintings at Berlin. "Among them," he says, "I found one which represents numerous animals in Paradise, one of which is a Dodo of about the same size and in nearly the same attitude as the one last mentioned. This picture was painted in 1626. Another picture of the Dodo, also by Roland Savery, date 1628, exists in the imperial collection of the Bellvedere at Vienna. The attitude is very different from that in the other pictures, giving the impression that Savery must have studied this bird from living specimens, and probably the one exhibited in London sat to Savery for his portraits."

The only existing recent remains attributed to the Dodo are—a leg in the British Museum, and a head (a cast of which is in Brit. Mus.), and a leg in the Ashmolean Museum at Oxford, the relics of Tradesoant's bird, and the head referred to by Professor Owen. Whether the leg formerly in the museum of Pauw be that at present in the British Museum may be perhaps doubtful, though we think with Dr. Gray that they are probably identical; but that the specimen in the British Museum did not belong to Tradeccant's specimen is clear, for it existed in the collection belonging to the Royal Society when Tradescant's 'Dodar' was complete. In the 'Annales des Sciences' (tom. xxi. p. 103, Sept. 1830) will be found an account of an assemblage of fossil bones, then recently discovered under a bed of lava in the Isle of France (Mauritius), and sent to the Paris Museum. They almost all belonged to a large living species of land-tortoise, called *Testudo Indica*, but amongst them were the head, sternum, and humerus of the Dodo. "M. Cuvier," adds Sir Charles Lyell in his 'Principles of Geology,' "showed me these valuable remains at Paris, and assured me that they left no doubt in his mind that the huge bird was one of the gallinaceous tribe."

Head of Dodo (from cast of Oxford specimen).

Foot of Dodo (specimen in the British Museum).

"Let us now endeavour," says Mr. Strickland, "to combine into one view the results of the historical, pictorial, and anatomical data which we possess respecting the Dodo.

"We must figure it to ourselves as a massive clumsy bird, ungraceful in its form, and with a slow waddling motion. We cannot form a better idea of it than by imagining a young duck or gosling enlarged to the dimensions of a swan. It affords one of those cases, of which we have many examples in zoology, where a species, or a part of the organs in a species, remains permanently undeveloped or in an infantine state. Such a condition has reference to peculiarities in the mode of life of the animal, which render certain organs unnecessary; and they therefore are retained through life in an imperfect state, instead of attaining that fully-developed condition which marks the mature age of the generality of animals. The Greenland Whale, for instance, may be called a permanent suckling; having no occasion for teeth the teeth never penetrate the gums, though in youth they are distinctly traceable in the dental groove of the jaws. The Proteus again is a permanent tadpole, destined to inhabit the waters which fill subterranean caverns; the gills which in other batrachian reptiles are cast off as the animal approaches maturity are here retained through life, while the eyes are mere subcutaneous specks, incapable of contributing to the sense of vision. And, lastly (not to multiply examples), the Dodo is (or rather was) a permanent nestling, clothed with down instead of feathers, and with the wings and tail so short and feeble as to be utterly unsubservient to flight. It may appear at first sight difficult to account for the presence of organs which are practically useless. Why, it may be asked, does the whale possess the germs of teeth which are never used for mastication? Why has the proteus eyes, when he is especially created to dwell in darkness? and why was the dodo endowed with wings at all, when those wings were useless for locomotion? This question is too wide and too deep to plunge into at present. I will merely observe that these apparently anomalous facts are really the indications of laws which the Creator has been pleased to follow in the construction of organised beings. They are inscriptions in an unknown hieroglyphic, which we are quite sure mean something, but of which we have scarcely begun to master the alphabet. There appear however reasonable grounds for believing that the Creator has assigned to each class of animals a definite type, or structure, from which he has never departed, even in the most exceptional or eccentric modifications of form. Thus if we suppose, for instance, that the abstract idea of a mammal implied the presence of wings, we may then comprehend why in the whale, the proteus, and the dodo, these organs are merely suppressed, and not wholly annihilated. And let us beware of attributing anything like imperfection to these anomalous organisms, however deficient they may be in those complicated structures which we so much admire in other creatures. Each animal and plant has received its peculiar organisation for the purpose, not of exciting the admiration of other beings, but of sustaining its own existence. Its perfection therefore consists, not in the number or complication of its organs, but in the adaptation of its whole structure to the external circumstances in which it is destined to live, and in this point of view we shall find that every department of the organic creation is equally perfect; the humblest animalcule, or the simplest *Conferva*, being as completely organised with reference to its appropriate habitat and its destined functions as man himself, who claims to be lord of all. Such a view of the creation is surely more philosophical than the crude and profane idea entertained by Buffon and his disciples, one of whom calls the dodo 'un oiseau bizarre, dont toutes les parties portaient le caractère d'une conception manquée.' He fancies that this imperfection was the result of the youthful impatience of the newly-formed volcanic islands which gave birth to the dodo, and implies that a steady old continent would have produced a much better article."

We now pass to the consideration of the place this apparently anomalous bird ought to occupy in the systems of classification of zoologists.

Piso, in his edition of Bontius, places the Dodo immediately before the Cassowary; and here we may observe that the figure of Bontius does not appear to be identical with the picture which now hangs in the British Museum. Though there is a general resemblance there are particular differences which go far to show, at all events, that the figure of Bontius and that in the picture are different portraits.

Willughby's eighth chapter treats of 'The greatest land-birds, of a peculiar kind by themselves, which by reason of the bulk of their bodies and the smallness of their wings cannot fly, but only walk.' The Ostrich occupies the first section of this chapter, and the Dodo the fourth and last, being immediately preceded by the Cassowary or Emeu. Ray's section 'Aves rostris rectioribus nimiusque hamatis maximæ, singulares et sui generis, ob corporum molem et alarum brevitatem volandi impotes' contains the same birds as Willughby's eighth chapter, namely, the Ostrich, the American Ostrich, the Emeu, Eme, or Cassowary, and lastly the Dodo.

Moehring, and after him Brisson, gives the bird under the name of *Raphus* a position next to the Ostriches also.

Buffon places it independently.

Linnæus, in his last edition of the 'Systema Naturæ' (the 12th, 1766), places the bird at the head of his *Gallinæ*, the order immediately succeeding the *Grallæ*, under the name of *Didus ineptus*, and immediately before the genus *Pavo* (Peacocks). The genus *Struthio* is the last of his *Grallæ*, and *Rhea* (American Ostrich) the last species of *Struthio*, so that *Didus ineptus* stands between *Struthio Rhea*, Linn., and *Pavo cristatus* (the Peacock). In a former edition Linnæus had noticed the bird under the name *Struthio cucullatus*.

Latham in his synopsis (1782) followed Linnæus, but gave three species: namely, the Hooded Dodo, the Solitary Dodo, and the Nazarene Dodo.

Gmelin, in his edition of the 'Systema Naturæ' (1789), makes *Psophia* (Trumpeter) the last genus of the Linnæan *Grallæ*, and *Otis* (Bustard) the first genus of the Linnæan *Gallinæ*, under which last-mentioned order he arranges the genus *Didus*, placing it between the genera *Struthio* and *Pavo*, which are both included by Gmelin in the order *Gallinæ*. He also gives three species—1st, *Didus ineptus*, which he describes as "black, clouded with white, with tetradactyle feet." The following are his synonyms:—*Didus*, 'Syst. Nat.' xii. 1, p. 267, n. 1; *Struthio cucullatus*, 'Syst. Nat.' x. p. 155; *Raphus*, Briss. 'Av.' 5, p. 14, n. 1; *Cygnus cucullatus*, Nieremb. 'Nat.' 231; *Gallus gallinaceus peregrinus*, Clus. 'Exot.' 99, t. 10; Olear. 'Mus.' 23, t. 13, f. 5; Dronte, Bont. 'Jav.' 70; Buff. 'Hist. Nat. des Ois.' i. p. 480; Dod-aersen, or Valgh-Vogel, Herbert, it. p. 382, t. 383; Dodo, Raj. 'Av.' p. 37, n. 8; Will. 'Orn.' p. 153, t. 27; Edw. 'Glean.' t. 294; Hooded Dodo, Lath. 'Syn.' iii. 1, p. 1, t. 70. 2nd, *Didus solitarius*, Solitaire, Buff. 'Hist. Nat. des Ois.' i. p. 485; Leguat, it. i. p. 98; Solitary Dodo, Lath. 'Syn.' iii. 1, p. 3, n. 2. This species is described by Gmelin as "varied with gray and brown, with tetradactyle feet." 3rd, *Didus Nazarenus*, Oiseau de Nazareth, et Oiseau de Nausée, Buff. 'Hist. Nat. des Ois.' i. p. 485; Cauche, 'Madag.' p. 130; Nazarene Dodo, Lath. 'Syn.' iii. 1, p. 4, n. 3. Gmelin describes this species as "black, with tetradactyle feet."

Blumenbach followed Linnæus; and Duméril and Vieillot followed Latham.

Temminck instituted in his 'Analyse du Système Général d'Ornithologie' the order *Inertes* for the Dodo and the *Apteryx*; two birds, as Mr. Yarrell in his paper on the *Apteryx* ('Trans. Zool. Soc.' vol. i. p. 71) observes, differing decidedly from each other in their beaks; but in reference to their imperfect wings, as also in the nature of their external covering, having obvious relation to the species included in his order *Cursores*. "But," adds Mr. Yarrell, "the situation chosen for this order *Inertes*, at the extreme end of his systematic arrangement, leads me to infer that M. Temminck considered as imaginary the subjects for which it was formed."

Illiger, in his 'Prodromus' (1811), instituted the order *Inepti* for the reception of the Dodo alone, *Apteryx* not being then known, and he placed it immediately preceding his *Cursores*, containing the Struthious Birds.

Cuvier, in the first edition of his 'Règne Animal,' at the end of his notice on his family *Brevipennes* (Les Autruches, *Struthio*, Linn.), has the following note appended to his description of the last species, *Rhea*.—"I cannot place in this table species but badly known, or, more, so little authentic as those which compose the genus *Didus*. The first, or the Dronte (*Didus ineptus*), is only known from a description given by the first Dutch navigators, and preserved by Clusius, 'Exot.' p. 99, and by an oil-painting of the same epoch copied by Edwards, pl. 294; for the description of Herbert is puerile, and all the others are copied from Clusius and Edwards. It would seem that the species has entirely disappeared, and we now possess no more of it at the present day than a foot preserved in the British Museum (Shaw, 'Nat. Miscell.' pl. 143), and a head in bad condition in the Ashmolean Museum at Oxford. The bill does not seem to be without some relation to that of the Auks (Pingouins), and the foot would bear considerable resemblance to that of the Penguins (Manchots) if it were palmated. The second species, or the Solitaire (*Didus solitarius*), rests only on the testimony of Leguat, 'Voy.' i. p. 98, a man who has disfigured the best known animals, such as the Hippopotamus and Lamantin. Finally, the third species, or L'Oiseau de Nazare (*Didus Nazarenus*), is only known through François Cauche, who regards it as the same as the Dronte, and yet only gives it three toes, while all other authors give four to the Dronte. No one has been able to see any of these birds since these voyagers." Cuvier's opinions subsequently underwent considerable modification. When he was in this country he had an opportunity of seeing the head preserved in the Ashmolean Museum, and the foot in the British Museum, and he doubted the identity of this species with that of which the painting is preserved in the national collection. Lyell mentions these doubts, and we must here recall to the reader the geologist's statement above alluded to, that Cuvier showed him the valuable remains in Paris, and that he assured him that they left no doubt on his mind that the huge bird was one of the Gallinaceous tribe. ('Sur quelques Ossemens,' &c., 'Ann. des Sci.' tome xxi. p. 103, Sept. 1830.)

Shaw, as appears indeed from Cuvier's note, made mention of the Dodo in his 'Naturalist's Miscellany' (plates 142 and 143), giving a figure of the head preserved in the Ashmolean Museum, and in his 'Zoological Lectures.'

Mr. Vigors in his paper 'On the Natural Affinities that connect the Orders and Families of Birds' ('Linn. Trans.' vol. xiv.) thus writes on the subject of the Dodo:—"The bird in question, from every account which we have of its economy, and from the appearance of its head and foot, is decidedly gallinaceous; and, from the insufficiency of its wings for the purposes of flight, it may with equal certainty be pronounced to be of the Struthious structure, and referable to the present family. But the foot has a strong hind toe, and, with the exception of its being more robust, in which character it still adheres to the *Struthionidæ*, it corresponds exactly with the foot of the Linnæan genus *Crax*, that commences the succeeding family."

M. Lesson, in his 'Manual' (1828), after giving a description of the Dodo (genus *Dronte*, *Didus*, Linn., *Raphus*, Moehring, Brisson), says that the genus includes but one species which may be considered as at all authenticated, and which exists no longer; this is the Dronte, *Didus ineptus*, described by Clusius, ex. p. 99, figured by Edwards, pl. 294. "They possess," he adds, "a foot and head of it at London, figured in Shaw's 'Miscell.' pl. 143 and 166." Then comes the following statement:—"M. Temminck has adopted, after Shaw, the genus *Apteryx*, which he thus describes." M. Lesson, after giving the description and noticing the only known species, *Apteryx Australis*, proceeds to make the following queries: "May not the Dronte be the Cassowary of the East Indies, to which has been added the bill of an Albatross? It is said that it was once very common in the Isles of France and of Bourbon, and that the former received the name of the Isle of Cerne from those birds. May not the *Apteryx* of M. Temminck be founded on the fragments of the Dronte preserved in the Museum of London?" To make the confusion complete, M. Lesson places immediately before the genus *Dronte* the *Emou Kirikiri*, *Dromiceius Novæ Zelandiæ*, Less., which is no other than the *Apteryx Australis* of Shaw, and which has been so well described and figured by Mr. Yarrell in the first volume of the 'Transactions of the Zoological Society of London.'

M. de Blainville, in a memoir on the 'Didus ineptus,' read before the Academy of Sciences, on the 30th of August, 1830, and published in the 'Nouvelles Annales du Muséum d'Histoire Naturelle' (tome iv. p. 1, 4to., Paris, 1835), enters at large into the history of the bird. After giving the different points on which the claim of the Dodo to be considered a gallinaceous bird rests, and the reasons for and against it, he thus proceeds:—"Among the orders of birds which include the largest species, there only remain the birds of prey with which the Dodo can be compared; and it seems to us that it is to them that the bird bears the greatest resemblance." In proof of this it is necessary to attend to the following observations:—

1. The eyes are situated in the same part of the bill as in *Cathartes*.
2. The nostrils are oval, situated very forward, and without a superior scale, as in those birds.
3. The form of the skull, its great width in the interorbitary space, and its flatness at the sinciput, are also nearly the same as in those vultures.
4. Even the colour of the bill, and the two caruncular folds of the origin of the curved part, are nearly the same as in those birds.
5. The species of hood which the skin forms at the root of the bill, and which have earned for the Dodo the name of *Cygnus cucullatus*, has a very similar disposition in *Cathartes*.
6. The almost entire nudity of the neck, as well as its greenish colour seen through the few downy feathers which cover it, are also characteristic of the vulture.

7. The form, the number, and the disposition of the toes, as well as the force and curvature of the clawe, indicate a hird of that family at least as much as a Gallinaceoue Bird.

8. The ecaly eystem of the tarsi and of the toes more resembles also what ie found in *Cathartes* than what is observed in the Gallinaceous Birds.

9. The kind of Jabot at the root of the neck, and even the muscular etomach, are found in one order as well as in the other.

10. Lastly, M. de Blainville noticee the absence of the spur (l'ergot), which he remarks is nearly characteristic of the Gallinaceoue Birds.

M. de Blainville, after expressing a hope that both the Aye-Aye (*Cheiromys*, which has not been eeen a second time since the days of Sonnerat) and the Dodo may be yet recovered in the interior of Madagascar, thus concludes his memoir :—

"1. There exist in the English collectious traces of at least three individuals of a large species of walking bird (oiseau marcheur), to which has been given the name of Dodo, Dronte, *Didus ineptus*.

"2. These tracee exist in Europe eince the epoch when the Dutch began to take part in the diecovery of the passage to the East Indies by the Cape of Good Hope, that ie to say, about 1594.

"3. The name of Dodo is employed for the first time hy Herbert, that of Dronte by Piso, hut without its heing possible to arrive at the origin and etymology of these denominations.

"4. The country of this bird is the Isle of France; there being nothing to prove positively that it has been found either at Bourbon or at Fernandez, as has been thought, owing to the confusion, no douht, between the Dodo and Solitaire of Leguat.

"5. The Dronte should be approximated to or even placed in the order of Rapacious Birds, near the vultures, rather than in that of the Gallinaceous Birds; and, for stronger reasons, rather than among the *Grallatores* (Echassiers), or near the Penguine (Manchots).

"6. It is by no means certain that thie bird has disappeared from the number of living animals. If thie is possihle in the case of the Iele of France, it is not probahle in the case of Madagascar, the productions of which are so little known, and which helongs, up to a certain point, to the same archipelago.

"There remains another question to discuss, namely, whether the incrusted bonee which have been lately sent to M. Cuvier from the Isle of France really belonged to the Dodo, as M. Cuvier was led to believe. It is a question which would be most easily eolved by the immediate comparisou of these hones with the pieces preserved in England. If thie was so, which the difference of height in the tarsal boue does not permit us to helieve, it would be at the same time proved that the Dodo existed also at Rodriguez, for these bonee have becu found in this isle in a cave (grotte), as M. Quoy, who saw them on his passage to the Isle of France, has assured me; and not at the Isle of France under bede of lava, as M. Cuvier has stated from erroneous information in his note read lately to the academy. Then there would be nearly a certainty that the Dodo was a Gallinaceous Bird; hut in making the observation that these bones come from the Isle of Fernandez, and that the descriptiou of the Solitaire of Leguat accords sufficiently well with a bird of this order, or at least with a Gallino-Gralle, it might he that the hones actually in the hands of M. Cuvier were no other than those of the Solitary Bird properly so called, and not those of the true Dronte."

The memoir is illustrated with four plates. The first is a coloured copy of the head of the Dodo from the Museum portrait, of the size of the original. In the painting, the author observee, the head is at least a foot long from the occiput to the extremity of the bill; but the head at Oxford is only eight inches and a half, or about two-thirds. The bill, he adds, makes out nearly three-fourthe of the wholo length. The eecond plate gives a profile of the Oxford head from a sketch taken from the original, and a view of the same seen from above, and skulls of the *Urubu* and *Vultur Papa*. The third plate gives two views of the foot preserved in the British Museum, and the remains of the foot at Oxford; a foot of the Heath-Cock (Coq de Bruyère), a foot of a Penguin, and a foot of *Vultur Papa*. The fourth plate gives a profile of the cast of the head at Oxford, aud a view of the same seen from below.

In the British Museum (1837), in cases 65-68 (Room xiii.), are the Ostrich; Bustards "which in many respects are allied to the Gallinaceous Birds;" the foot and cast of the head of the Dodo above alluded to; the Courser and Pratincole; and at page 99 of tho 'Synopsis' (1832) we have the following observations :—"Over the door adjoiuing the twelfth room is an original paiuting of the Dodo, preseuted to the Museum by George Edwards, Esq., the celebrated ornithological artist, and copied in hie worke, plate No. 294, who says it was 'drawn in Holland from a living bird hrought from St. Maurice'e Island in the East Indies.' The only remains of this bird at preeent known are a foot (case 65) in this collection (preeented hy the Royal Society), and a head and foot said to havo belonged to a epecimen which was formerly in Tradescant's Museum, hut ie now in the Ashmolean Museum at Oxford. The cast of the head above meutioned (in the same case) was presented hy P. Duncan, Esq. The bird in the shortness of the wings resemhlce the ostrich, but its foot in general rather resembles that of the common fowl, and the heak from the position of its nostrils is most nearly allied to tho vultures; so that its true place in the series of birds, if indeed such a hird ever really existed, is not as yet eatisfactorily determined."

Mr. Swaiuson ('Natural History aud Claseification of Birds,' 1836), speaking of the birds of prey, says (p. 285) :—"The third and last type of this family appears to us to be the Secretary Vulture of Africa, forming the genus *Gypogeranus*. At least we canuot assign it to any other known division of the *Raptores* without separating it much more widely from its congeners thau our present state of knowledge will sanction. It hae been thought indeed that this remarkable bird represented one of the primary divisions of the whole order, in which case it would etand between the owls and the Dodo; but its similarity to the vulturee and the falcons in our opiniou is too great to favour this supposition; while, on the other hand, it will subsequently appear that the circle of the *Falconidæ* is sufficiently complete to show that it does not enter into that family." After some other observations Mr. Swainson concludee his remarks on the Secretary thus :—"It must be rememhered also that the very same objections occur agaiust placing this hird (the Secretary) hetween the *Strigidæ* (Owls) and the *Didide* (Dodos) as those we have intimated against considering it as the grallatorial type of the *Vulturidæ*."

That a hird or birds called by the name of Dodo and the other appellations which we need not here repeat once existed, we think the evidence above given eufficiently provee. We have indeed heard doubte expressed whether the Museum portrait was taken "from a living hird," and have also heard it euggested that the picture may represeut a epecimen made up of the hody of an ostrich to which the bill and legs of other hirds have been attached; and here it is that the destruction of Tradescant'e specimen hecomes a source of the greatest regret. Whatever was the condition of that specimen, as long as the skin was preserved there existed the means of ascertaining whether it was real or a made-up monster; and when the vice-chancellor and the other curators, in making their lustratiou, gave the fatal nod of approbation they destroyed that evidence. With regard to the picture, we have endeavoured to place it before tho reader as well as our limited meaue will permit, in order that he may have an opportunity of judging from the internal evidence as to the probability of the portrait being taken from a living bird, and with this view we have given the accessories as they appear in the painting as well ae the principal figure.

Dr. J. E. Gray, among others, still inclines, we believe, to the opinion that the bird represented was made up hy joining the head of a bird of prey approaching the Vultures, if not belouging to that family, to the lege of a Gallinaceous Bird; and his opiniou, from his attainmente and experience, is worthy of all reepect. Hie reasous for conеidering the Dodo as helonging to the *Raptores* chiefly rest ou the following facts, premising, as he does, that it ie to bo horne in mind that in the Raptorial Birds the form of the bill is their chief ordinal character, which is not the caso with the *Grallatores* or the *Natatores*, where the form of the feet and lege are the chief character of the order :—

"1. The base of the bill is enveloped in a cere, as may be eeen in the cast, where the folds of tho cere are distinctly exhibited, especially over the back of the nostrils. The cere is ouly found in the Raptorial Birds.

"2. The nostrile are placed exactly in frout of the cere, as they are iu the other *Raptores*; they are oval, and nearly erect, as they are in the True Vultures, and in that genus alone; and uot longitudinal as they are in the *Cathartes*, all the Gallinaceous Birds, *Grallatores*, aud *Natatores*; aud they are uaked, and covered with an arched scale, as ie the case in all the *Gallinaceæ*.

"3. In Edwards's picture the bill is represented as much hooked (like the *Raptores*) at the tip; a character which unfortunately cannot be verified ou the Oxford head, as that speciuicu is destitute of the horny sheath of the hill, and only showe tho form of the bony core.

"With regard to the eize of the bill, it is to be ohserved that this part variee greatly in the different species of Vultures; indeed so much so, that there is no reasou to helieve that the hird of the Oxford head wae much larger than some of the known Vultures.

"With regard to the foot," adds Dr. Gray, "it has all the characters of that of the Galliuaceous Birds, and differe from all tho Vultures in the shortness of the middle toe, the form of the scalee on tho leg, and the bluntness of the clawe."

But if we grant Dr. Gray's poeition, see what we have to deal with. We have theu two species, which are either extinct or have escaped the researches of all zoologists, to account for: one, a hird of prey, to judge from its bill, larger than the condor; the other a Galliuaceous Bird, whose pillar-like legs must have supported au enormoue body. As to the stories of the disgusting quality of the flesh of the bird found and eaten by the Dutch, that will weigh but little in the scale when we take the expression to be, what it really was, indicative of a comparative preference for the turtle-doves there found after feeding on Dodos 'usque et nauseam.' "Always partridges" has become almost proverbial, and we find from Lawson how a repetition of the most delicious food palls. "We cooked our supper," eays that traveller, "but having neither bread nor salt our fat turkeys began to be loathsome to us; although we were never wantiug of a good appetite, yet a coutinuance of one diet mado us weary;" and again: "By the way our guide killed more turkeys, and two pole-cats, which he eat, esteeming them before fat turkeys."

With regard to the form of the bill, we must be careful how we lay too much stress on that. Who would have expected to find a bill "long, slender, smooth, and polished, in form resembling that of an Ibis, but rather more straight and depressed at the base," on an Emeu-like body with rasorial legs and feet? Yet such is the form of *Apteryx*. As to the argument arising from the absence of the spur, it is worth but little at best; and it may be said in favour of those who would place the Dodo between the Struthious and Gallinacious Birds, that its absence in such an osculant bird would be expected.

If the picture in the British Museum and the cut in Bontius be faithful representations of a creature then living, to make such a bird a bird of prey—a Vulture, in the ordinary acceptation of the term—would be to set all the usual laws of adaptation at defiance. A Vulture without wings! How was it to be fed? And not only without wings, but necessarily slow and heavy in progression on its clumsy feet. The *Vulturidæ* are, as we know, among the most active agents for removing the rapidly decomposing animal remains in tropical and intertropical climates, and they are provided with a prodigal development of wing to waft them speedily to the spot tainted by the corrupt incumbrance. But no such powers of wing would be required by a bird appointed to clear away the decaying and decomposing masses of a luxuriant tropical vegetation—a kind of Vulture for vegetable impurities, so to speak—and such an office would not be by any means inconsistent with comparative slowness of pedestrian motion.

Nevertheless we have the following expression of opinion from Professor Owen, who in 1845 published a paper on the subject of the Dodo in the 'Transactions of the Zoological Society.' He concludes his paper thus: "Upon the whole then the Raptorial character prevails most in the structure of the foot as in the general form of the beak of the Dodo, and the present limited amount of our anatomical knowlege of the extinct terrestrial bird of the Mauritius supports the conclusion that it is an extremely modified form of the Raptorial order. Devoid of the power of flight, it could have had small chance of obtaining food by preying upon the members of its own class; and if it did not exclusively subsist on dead and decaying organised matter, it most probably restricted its attacks to the class of reptiles and to the littoral fishes, *Crustacea*, &c., which its well developed back toe and claw would enable it to seize and hold with a firm gripe."

Mr. Strickland, who is the last writer upon the affinities of the Dodo, and has produced a work quite exhaustive of the subject, refers the Dodo to the *Columbidæ*.

"The extensive group of *Columbidæ*, or Pigeons," says Mr. Strickland, "is very isolated in character, and though probably intermediate between the Insessorial and Gallinaceous orders, can with difficulty be referred to either. In this group we find some genera that live wholly in trees, others which are entirely terrestrial, while the majority, of which the common Wood-Pigeon is an instance, combine both these modes of life. But the main characteristic of all is their diet, composed almost exclusively of the seeds of various plants and trees. We accordingly find much diversity in the forms of their beaks, according to the size and mechanical structure of the seeds on which each genus is destined to live. Those which feed on cereal grains and the seeds of small grasses and other plants, like the Common Pigeon and Turtle-Dove, have the beak considerably elongated, feeble, and slender. But in tropical countries there are several groups of Pigeons called Nutmeg-Eaters and Trerons, which feed on the large fruits and berries of various kinds of palms, fig, nutmeg, and other trees. These birds, and especially those of the genus *Treron* (*Vinago* of Cuvier) have the beak much stouter than other pigeons, the corneous portion being strongly arched and compressed, so as greatly to resemble the structure of certain Rapacious Birds, especially of the Vulturine family. This Raptorial form of beak is carried to the greatest extent in the genus *Didunculus*, a very singular bird of the Samoan Islands in the Pacific Ocean. Very little is yet known of its habits, but Mr. Stair, a missionary recently returned from those islands, has reported that the bird feeds on bulbous roots. Its first discoverer, Mr. Titian Peale, an American naturalist (whose account is I believe still unpublished) saw something in its form or habits that reminded him of the Dodo, and hence its generic name. Sir W. Jardine, who first described the bird, under the name of *Gnathodon strigirostris* in the 'Annals of Natural History,' vol. xvi. p. 175, referred it conjecturally to the *Megapodidæ*, though he recognised in it several dove-like characters. And Mr. Gould, who has given two figures of it in his 'Birds of Australia,' part 22, pronounces that the bird approaches nearest to the Pigeons. We shall soon see that the Didine and Columbine hypotheses, though apparently incongruous, resolve themselves (as often happens) into one truth.

"Although certain genera of *Columbidæ* are thus seen to assume a form of beak resembling that of the *Raptores*, yet no two groups in the same class can be more opposed in habits and affinities than the 'feroces Aquilæ' and 'imbelles Columbæ.' It is interesting however to observe that mechanical strength, whether for the devouring of animal or vegetable substances, is obtained in both cases by a similarity of structure.

"If now we regard the Dodo as an extreme modification, not of the vultures, but of these vulture-like frugivorous pigeons, we shall, I think, class it in a group whose characters are far more consistent with what we know of its structure and habits. There is no à priori reason why a pigeon should not be so modified in conformity with external circumstances as to be incapable of flight, just as we see a Grallatorial Bird modified into an Ostrich, and a Diver into a Penguin. Now, we are told that Mauritius, an island forty miles in length and about one hundred miles from the nearest land, was when discovered clothed with dense forests of palms and various other trees. A bird adapted to feed on the fruits produced by these forests would in that equable climate have no occasion to migrate to distant lands; it would revel in the perpetual luxuriance of tropical vegetation, and would have but little need of locomotion. Why then should it have the means of flying? Such a bird might wander from tree to tree, tearing with its powerful beak the fruits which strewed the ground, and digesting their strong kernels with its powerful gizzard, enjoying tranquillity and abundance, until the arrival of man destroyed the balance of animal life, and put a term to its existence. Such in my opinion was the Dodo, a colossal brevipennate frugivorous pigeon."

The first idea of referring the Dodo to the Pigeons seems to have occurred to Professor Reinhardt of Copenhagen. To Mr. Strickland however must be given the credit of laboriously working out this idea. We can here only refer to his volume, 'The Dodo and its Kindred,' for further information. In working out the anatomical details he was assisted by Dr. Melville, now Professor of Natural History, Queen's College, Galway, Ireland. This part of the work is remarkable for the detailed manner in which the subject is gone into, and the beautiful illustrations which accompany the text.

We have now to draw attention to another part of this subject. In speaking of the Dodo several references have been made to a bird called the Solitaire, and many of the writers quoted have confounded it with the Dodo, or made it a second species. This bird was first described by Leguat, who was for many years the commander of a party of French Protestant refugees who settled upon the island of Rodriguez in the year 1691. In his description * of the isle, which is called either Diego-Rodrigo, or Diego-Ruys, or Rodrigo, he gives the following account:—"We had also another creek on the other side of our cabins, and full of oysters sticking to the rock. We went often to breakfast there, and brought some home, with which we made an excellent ragout with palm-tree cabbages and turtle's fat. Of all the birds in the island the most remarkable is that which goes by the name of the Solitary (le Solitaire), because it is very seldom seen in company, though there are abundance of them. The feathers of the males are of a brown-gray colour; the feet and beak are like a turkey's, but a little more crooked. They have scarce any tail, but their hind part, covered with feathers, is roundish like the crupper of a horse. They are taller than turkeys. Their neck is straight, and a little longer in proportion than a turkey's, when it lifts up its head. Its eye is black and lively, and its head without comb or cop. They never fly; their wings are too little to support the weight of their bodies; they serve only to beat themselves and flutter when they call one another. They will whirl about for twenty or thirty times together on the same side during the space of four or five minutes; the motion of their wings makes then a noise very like that of a rattle, and one may hear it two hundred paces off. The bone of their wing grows greater towards the extremity, and forms a little round mass under the feathers as big as a musket-ball: that and its beak are the chief defence of this bird. 'Tis very hard to catch it in the woods, but easy in open places, because we run faster than they, and sometimes we approach them without much trouble. From March to September they are extremely fat, and taste admirably well, especially while they are young. Some of the males weigh forty-five pound.

"The females are wonderfully beautiful, some fair, some brown: I call them fair because they are of the colour of fair hair. They have a sort of peak, like a widow's, upon their breasts, which is of a dun colour. No one feather is straggling from the other all over their bodies, being very careful to adjust themselves and make them all even with their beaks. The feathers on their thighs are round like shells at the end, and being there very thick, have an agreeable effect; they have two risings on their craws, and the feathers are whiter there than the rest, which livelily represent the fine neck of a beautiful woman. They walk with so much stateliness and good grace, that one cannot help admiring them and loving them, by which means their fine mien often saves their lives.

"Though these birds will sometimes very familiarly come up near enough to one when we do not run after them, yet they will never grow tame; as soon as they are caught they shed tears without crying, and refuse all manner of sustenance till they die. We find in the gizzards of both male and female a brown stone, of the bigness of a hen's egg; it is somewhat rough, flat on one side, and round on the other, heavy and hard. We believe this stone was there when they were hatched, for let them be never so young you meet with it always. They have never but one of them; and besides, the passage from the craw to the gizzard is so narrow that a like mass of half the bigness could not pass. It served to whet our knives better than any other stone whatsoever. When these birds build their nests they choose a clean place, gather together some palm-leaves for that purpose, and

* 'A new Voyage to the East Indies by Francis Leguat and his Companions, containing their Adventures in two Desert Islands,' &c., 8vo., London, 1708.

heap them up a foot and a half high from the ground, on which they sit. They never lay but one egg, which is much bigger than that of a goose. The male and female both cover it in their turns, and the young is not hatched till at seven weeks' end. All the while they are sitting upon it, or are bringing up their young one, which is not able to provide for itself in several months, they will not suffer any other bird of their species to come within two hundred yards round of the place; but what is very singular is, the males will never drive away the females, only when he perceives one he makes a noise with his wings to call the female, and she drives the unwelcome stranger away, not leaving it till it is without her bounds. The female does the same as to the males, whom she leaves to the male, and he drives them away. We have observed this several times, and I affirm it to be true. The combats between them on this occasion last sometimes pretty long, because the stranger only turns about, and does not fly directly from the nest; however the others do not forsake it till they have quite driven it out of their limits. After these birds have raised their young one, and left it to itself, they are always together, which the other birds are not; and though they happen to mingle with other birds of the same species, these two companions never disunite. We have often remarked, that some days after the young one leaves the nest, a company of thirty or forty brings another young one to it, and the new-fledged bird, with its father and mother joining with the band, march to some bye-place. We frequently followed them, and found that afterwards the old ones went each their way alone, or in couples, and left the two young ones together, which we called a marriage. This particularity has something in it which looks a little fabulous; nevertheless, what I say is sincere truth, and what I have more than once observed with care and pleasure." The worthy narrator then indulges in some reflections on marriages in general, and early marriages in particular. It is worthy of note, with reference to the alleged juxtaposition of the bones of a large land-turtle and those of the Dodo, to which we shall have occasion to allude, that the same author, in the description of the same island, speaks of the multitude of land-turtles; of which he says, "I have seen one that weighed one hundred pound, and had flesh enough about it to feed a good number of men."

Solitary Bird of Leguat.

The preceding cut is copied from Leguat's figure of 'the Solitary Bird.'

In the frontispiece is represented one in a sort of landscape, and also land-turtles; and in 'a plan of the settlement' in the island of Rodrigo, many, some in pairs, are placed about. This plan shows the situation of the houses, &c. of Leguat and his companions; there are also land-turtles and other animals.

Although Rodriguez is now a British colony we have no further testimony about living Solitaries. Persons resident on the spot have inquired with the same results as have attended inquiries after the Dodo in Mauritius. Bones, probably of this bird, have however been found.

In a letter addressed to the Secretary of the Zoological Society by Charles Telfair, Esq., Corr. Memb. Zool. Soc., dated Port Louis (Mauritius), November 8, 1832, and read before a meeting of the society on the 12th March 1833, it appeared that Mr. Telfair had recently had opportunities of making some researches about the buried bones of the Dronte or Dodo found in the Island of Rodriguez. The result of these researches he communicated, and inclosed letters addressed to him by Colonel Dawkins, military secretary to the Governor of the Mauritius, and by M. Eudes, resident at Rodriguez.

Colonel Dawkins, it was stated, in a recent visit to Rodriguez, conversed with every person whom he met respecting the Dodo, and became convinced that the bird does not exist there. The general statement was that no bird is to be found there except the Guinea-Fowl and Parrot. From one person however he learned the existence of another bird, which was called Oiseau-Bœuf, a name derived from its voice, which resembles that of a cow. From the description given of it by his informant, Colonel Dawkins at first believed that this bird was really the Dodo; but on obtaining a specimen of it, it proved to be a Gannet (apparently referrible to the Lesser Gannet of Dr. Latham, the *Sula candida* of Brisson, and the *Pelecanus Piscator* of Linnæus). It is found only in the most secluded parts of the island. Colonel Dawkins visited the caverns in which bones have been dug up, and dug in several places, but found only small pieces of bone. A beautiful rich soil forms the ground-work of them, which is from six to eight feet deep, and contains no pebbles. No animal of any description inhabits these caves, not even bats.

M. Eudes succeeded in digging up in the large cavern various bones, including some of a large kind of bird, which no longer exists in the island: these he forwarded to Mr. Telfair, by whom they were presented to the Zoological Society. The only part of the cavern in which they were found was at the entrance, where the darkness begins; the little attention usually paid to this part by visiters may be the reason why they have not been previously found. Those near the surface were the least injured, and they occur to the depth of three feet, but no where in considerable quantity; whence M. Eudes conjectured that the bird was at all times rare, or at least uncommon. A bird of so large a size as that indicated by the bones had never been seen by M. Gory, who had resided forty years on the island. M. Eudes added that the Dutch who first landed at Rodriguez left cats there to destroy the rats which annoyed them: these cats have since become very numerous, and prove highly destructive to poultry; and he suggested the probability that they may have destroyed the large kind of bird to which the bones belonged, by devouring the young ones as soon as they were hatched—a destruction which may have been completed long before the island was inhabited.

The bones procured by M. Eudes for Mr. Telfair were presented by that gentleman to the Zoological Society. At the reading of the letter, &c., they were laid on the table, and consisted of numerous bones of the extremities of one or more large species of Tortoise, several bones of the hinder extremity of a large bird, and the head of a humerus. With reference to the metatarsal bone of the bird, which was long and strong, Dr. Grant pointed out that it possessed articulating surfaces for four toes, three directed forwards and one backwards, as in the foot of the Dodo preserved in the British Museum, to which it was also proportioned in its magnitude and form. ('Zool. Proc.' 1833, Part 1.)

The bones belonging to the birds here spoken of, Mr. Strickland believes were those of the Solitaire. They were lost before he began to investigate the subject. He however had an opportunity of examining the bones before alluded to as preserved in the Museum in Paris, and also a collection of bones made by Mr. Telfair in Rodriguez, and now in the Andersonian Museum at Glasgow. The bones from Paris and Glasgow were found to agree, and were referrible to a bird having the characters of the Solitaire as described by Leguat. They however differed from those of the Dodo, but were found to present affinities to the *Columbidæ* equally as strong as those of the Dodo.

From occasional notices amongst early travellers, Mr. Strickland comes to the conclusion that also in the island of Bourbon there formerly existed a brevipennate bird or birds, homologous with the Dodo and Solitaire, that are now extinct. He refers also to a notice by Flacourt of a large brevipennate bird as an inhabitant of Madagascar. He thus concludes this part of his work:—"On a review of the various historical and osteological evidences which I have now brought together, it seems sufficiently clear that the three oceanic islands, Mauritius, Rodriguez, and Bourbon, which, though somewhat remote from each other, may be considered as forming one geographical group, were inhabited until the time of their human colonisation by at least four distinct but probably allied species of brevipennate birds. This result at once reminds us of the analagous case of the New Zealand group of islands, where the scientific zeal of Messrs. Cotton, Williams, Colenso, Mantell, and others has brought to light a mine of osteological treasures, from which the consummate sagacity of Professor Owen has reconstructed two new genera of brevipennate birds. Seven species of *Dinornis* and two of *Palapteryx* have been clearly established and elaborately described by Professor Owen; while in the still surviving genus *Apteryx*, of which Mr. Gould has very recently described a second species, we see an almost expiring member of the same zoological group. The extraordinary success of the naturalists of New Zealand in procuring from recent alluvial deposits a series of osseous remains which have more than doubled the number of struthoid birds previously known, should encourage the scientific residents in the islands of the Indo-African Sea to make similar researches. I feel confident that if an active naturalist would make a series of excavations in the alluvial deposits in the beds of streams and amid the ruins of old habitations in the Mauritius, Bourbon, and Rodriguez, he would speedily discover remains of the Dodo, the two Solitaires, or the Oiseau Bleu. But I would especially direct the attention to the caves with which those volcanic islands abound. The chief agents in the destruction of the brevipennate birds were probably the runaway negroes who for many years infested the primæval forests of those islands, and inhabited the caverns, where they would doubtless leave the scattered bones of the animals on which they fed. Here then may we more especially hope to find the osseous remains of these remarkable animals. Should any copies of this work find their way to Mauritius or Bourbon they may perhaps incite the lovers of knowledge in those islands to investigate further the subject, which has been diligently but imperfectly pursued in this volume; and I shall feel rewarded for the trouble it has cost, if my researches into the history and organisation of these birds, aided by the anatomical investigations which Dr. Melville has introduced into the second part of the work, shall have rescued these anomalous creatures from the domain of fiction, and established their true rank in the scheme of creation."

DOG. [CANIS.]

DOGBANE. [APOCYNACEÆ.]

DOG-FISH. [SQUALIDÆ.]

DOG-ROSE. [ROSA.]

DOG'S-TAIL-GRASS. [CYNOSURUS.]

DOG'S-TOOTH-SPAR. [CALCAREOUS SPAR.]

DOG-WOOD. [CORNUS.]

DOLABELLA. [TECTIBRANCHIATA.]

DOLABRIFORM, a term applied in Botany to certain fleshy leaves, which are straight at the front, taper at the base, compressed, dilated, rounded, and thinned away at the upper end at the back, so as to bear some resemblance to an old-fashioned axe-head.

DOLERITE, a form of Basalt consisting of *Labradorite* and *Augite*.

DOLICHONYX. [BOB-O-LINK.]

DO'LICHOS. Under this name Linnæus included the greater part of those tropical twining Leguminous Plants which bear eatable fruit like the kidney-beans cultivated in Europe. A large number of species, ill distinguished from each other, and differing materially in the structure of their fructification, were for so long a time collected under this name that, although they are now broken up into several genera, we shall briefly notice the more remarkable in this place.

Dolichos itself is confined to the species with a compressed linear pod, having incomplete cellular dissepiments, and ovate seeds with a small oval hilum. Of these *D. Catjang*, the pulse of which is called Boberloo in India, is an annual, and has somewhat deltoid leaves, angular at the back, few-flowered peduncles, and erect pods. It is cultivated in the fields in many parts of India during the dry season, and its seeds are extensively consumed by the poorer natives. *D. lignosus*, a perennial, with long racemes of flowers, broad heart-shaped leaflets, and linear sharp-pointed pods, is extremely common all over India, where it is cultivated "during the cold season in gardens and about the doors of the natives, forming not only cool shady harbours, but furnishing them with an excellent pulse for their curries," &c. There are several varieties of it constituting the commonest kidney-beans of India. *D. biflorus*, an annual, with oblong pointed leaflets and scimitar-shaped hairy pods, furnishes the pulse called in India Horse-Gram; and *D. sphærospermus* produces the Calavana or Black-Eyed Peas of Jamaica.

Lablab has a compressed scimitar-shaped pod, rough, with tubercles at the sutures, and furnished with transverse imperfect cellular partitions, and ovate seeds with a fungous callous linear scar. *Lablab vulgaris*, the old *Dolichos Lablab*, is a common plant in the hedges in many parts of India, whence it has travelled into the tropical parts of America. It is a smooth perennial with showy white or purple flowers, and large horizontal pods, containing from three to four seeds. It has a heavy disagreeable bug-like smell, prefers a rich black soil that cannot be flooded by rains, and produces a coarse but wholesome pulse, much eaten by the lower classes in India.

Pachyrhizus has a long compressed pod, with kidney-shaped seeds and no dissepiments, and is remarkable for its principal species, *P. angulatus* (formerly *Dolichos bulbosus*), producing a root of the size and substance of a turnip. It is reported to have been carried to the Philippines from South America, and thence to have been introduced into the west of Asia. The side leaflets are nearly triangular, that in the middle lozenge-shaped, slightly toothed, and shaggy on both sides. The flowers are very beautiful, of a violet-blue colour, and arranged in axillary nearly erect racemes, from one to two feet long. Its root is a common article of food in the Malay Archipelago, but no other part of the plant is eaten.

In *Psophocarpus* the pods are oblong, and have four longitudinal wings; the seeds are roundish. It comprehends the *Dolichos tetragonolobus*, a twining annual, the pods or tuberous roots of which are a common Indian esculent.

Canavalia, with long straightish compressed pods, having three short wings at the lower suture, cellular dissepiments, and oblong seeds with a narrow hilum, comprehends the South American Lima Beans and the Sword Beans of India. The species have a handsomer and firmer foliage than the other genera, and the flowers are usually large and showy. *C. gladiata*, the common cultivated species, has often pods two feet long, and varies with red, gray, and white seeds.

Finally, the genus *Mucuna*, known by its oblong puckered compressed hispid pods, includes all the species from which Cowage is obtained. [COWITCH or COWAGE.]

DOLIOLUM. [ACALEPHÆ.]

DOLIUM. [ENTOMOSTOMATA.]

DOLOMITE, a variety of Magnesian Limestone, first noticed by Dolomieu. It occurs mostly massive, and in mountain masses; it is usually white, sometimes grayish or yellowish; its structure is sometimes slaty; it is frequently translucent on the edges. It is softer than common limestone. Sometimes it is met with in veins accompanied by quartz, carbonate of lime, &c. The Dolomite of the Apennines consists of 59 carbonate of lime and 40 carbonate of magnesia: it contains a variable quantity of oxide of iron.

Compact Dolomite or Gurhoffian is snow-white, and very compact. The surface, when newly broken, is scarcely shining, and the fragments, which are sharp, are translucent on the edges; the fracture is flat chonchoidal, and its hardness is considerable. It occurs in veins traversing serpentine between Gurhoff (whence its name) and Aggsbach, in Lower Austria. According to Klaproth, it consists of carbonate of lime 70·50, and carbonate of magnesia 29·50.

This rock, having the aspect and general geological history of limestone, but composed of carbonate of magnesia united to carbonate of lime, usually atom to atom, occurs as a part of the Oolitic system of the Alps and Apennines, and of the German Jurakalk; and it is perhaps proper to call by the same name the crystallised Magnesian Limestone of Nottinghamshire, Derbyshire, Yorkshire, and Durham. The best example of this English Dolomite is at Bolsover, in Derbyshire, from whence the stone is taken to build the new Houses of Parliament. From the manner in which this rock occurs along the Lake of Lugano, and other parts on the south side of the Alps, in direct contact or more frequently in a peculiar relation of propinquity to augitic traps, Von Buch inferred that Dolomite was a metamorphic limestone, altered by absorption of magnesian vapours yielded by volcanic action. There is much to recommend this inference. In England we frequently find the mountain limestone dolomitised, along lines of fracture and along the sides of mineral veins; and these cases appear to enter into Von Buch's explanation. But the broad Magnesian Limestones of the North of England are certainly due to original crystallisation together of the two carbonates already named. Dolomite is usually very deficient in organic remains. In the Alps and in Franconia its aspect is very picturesque.

The Magnesian Limestone belongs to a system of rocks called by modern geologists Permian, which includes the Zechstein Kupferschiefer and Roth-todte-ligende of German geologists. [PERMIAN SYSTEM.]

DOLPHIN. [CETACEA.]

DO'MBEYA, a genus of Plants belonging to the natural order *Byttneriaceæ*, inhabiting the East Indies and the isles of France, Bourbon, and Madagascar. They have a 5-parted persistent calyx, surrounded by a 3-leaved unilateral involucel. The petals are 5. The stamens are from 15 to 20, scarcely monadelphous, five of them being sterile, with from 2 to 3 fertile ones between each sterile stamen. The name *Dombeya* was also applied to the plant now called *Araucaria excelsa*. The bark of *D. spectabilis* is made into ropes in Madagascar.

DONAX. [ARUNDO.]

DONAX. [CONCHACEA.]

DOOM, or DOUM, a remarkable Palm-Tree exclusively inhabiting Upper Egypt, especially the neighbourhood of Thebes, whence it is named *Cucifera Thebaica*. Its stem, instead of growing without branches like other palms, forks two or three times, thus assuming the appearance of a Pandanus. Clumps of it occur near Thebes. The fruit is about the size of an orange, angular, irregularly formed, of a reddish colour, and has a spongy, tasteless, but nutritious rind. The albumen of the seed is hard and semitransparent, and is turned into beads and other little ornaments. Gærtner described it under the name of *Hyphæne coriacea*. It is known in Egypt as the Gingerbread-Tree, because of the resemblance of its brown mealy rind to that cake.

DORE'MA, a genus of Plants belonging to the natural order *Umbelliferæ*. It has an epigynous cup-shaped disc; the fruit slightly compressed from the back, and edged; 3 distinct filiform primary ridges near the middle, and alternating with them 4 obtuse secondary ridges, the whole enveloped in wool; vittæ 1 to each secondary ridge, 1 to each primary marginal ridge, and 4 to the commissure, of which 2 are very small.

D. ammoniacum is a glaucous green plant with a perennial root, large leaves 2 feet long, somewhat bipinnate, the pinnæ in three pairs, the leaflets inciso-pinnatifid, with oblong mucronulate entire or slightly-lobed segments from 1 to 5 inches long and half an inch to 2 inches broad; the petiole very large, downy, and sheathing at the base; the teeth of the calyx acute, membranous, minute; the petals ovate, reflexed at the point; the fruit elliptical, compressed, surrounded by a broad flat edge. This plant is a native of Persia, in the plains of Yerdekahst and Kumisha in the province of Irak; and near the town of Jezud Khāst in very dry plains and gravelly soil, exposed to an ardent sun. This plant is one of those which yields gum ammoniacum, but it is probable that there are several species of plants which yield this as well as the other gum-resins of the order *Umbelliferæ*.

(Lindley, *Flora Medica*.)

DORIPPE (Fabricius), a genus of Brachyurous Decapod *Crustacea* belonging to the sub-division which have the feet of the fourth and fifth pairs elevated on the back and not terminated with paddles, and the eyes supported upon simple peduncles (*Notopoda*). The genus is adopted by Latreille, Lamarck, Leach, Bosc, and Risso: it is the *Notogastropus* of Vosmaer, and was comprehended under the general term *Cancer* by Linnæus, Herbst, Aldrovandus, and Plancus. It has the following characters:—External antennæ rather long, setaceous, inserted above the intermediate ones, which are folded (pliées), but not entirely lodged in the cavities where they take their insertion; third joint of the external jaw-feet (pieds-mâchoires) straight, elongated, terminated in a point; buccal opening triangular; claws (chelæ) small, short, equal; the other feet very long and compressed, the third pair being the greatest; the last two pair elevated upon the back, and terminated by a small hooked nail, which is folded back upon the next joint. Carapace slightly depressed (the sides wider posteriorly than they are anteriorly), truncated, and spinous before; truncated, sinuous, and bordered behind; the surface marked with small humps or tubercles, which correspond exactly to the regions proper to the soft parts beneath. Two great oblique openings, ciliated on their edges, communicating with the branchial cavity and situated below the head, one at the right, the other at the left of the mouth. Inferior and posterior part of the body truncated into a kind of gutter to receive the reflected abdomen, the pieces of which are nodulous or tuberculous. Eyes small, lateral, supported on rather long peduncles, placed near the angles of the head, and protected by its angular projections, which form the edges of their orbits. (Desmarest.)

The Mediterranean and Adriatic seas, and Manilla, are among the localities in which the species have been found. They haunt great depths in the sea, nor has it yet been proved whether they make use of the feet elevated on the back to cover themselves like the *Dromiæ* with foreign bodies. It is however very probable that such is their use.

D. lanata, Latreille, Lamarck; *D. Facchino*, Risso; *Cancer lanatus*, Linnæus; *C. hirsutus alius*, Aldrovandus.

It has four dentations in the front and a very strong lateral point, forming at the same time the angle of the head and the external border of the orbit. A short point on the middle of each side of the carapace. Anterior border of the thighs of the second and third pair of feet without spines. Fingers of the chelæ compressed and arched within, having their internal edge armed with a series of dentilations, which are rather strong, oblique, equal, and white. Body often covered with reddish down.

Dorippe lanata.
a, external left jaw-foot.

It inhabits the Mediterranean and the Adriatic seas. The inhabitants of Rimini call it Facchino. (Desmarest.)

Fossil Dorippe.

Desmarest ('Histoire Naturelle des Crustacés Fossiles,' 1822) describes a species, *D. Rissoana*, which has some resemblance to the species above figured and described, and still more to the crab figured by Herbst under the name of *Cancer Frascone*; and above all to a species brought from Australia by Péron, and named *D. nodosa*. Desmarest observes that he is the more inclined to consider it as approaching very near to this last, inasmuch as he had thought that the specimen which he had described might not be in reality fossil. In fact, he adds, that though brown and shining, like the fossil crabs which come from the East Indies, it is much lighter, more friable, and not so much imbedded in the clay as they are. In his 'Considérations Générales sur la Classe des Crustacés' (1825) he describes the Dorippe à Quatre Dents with the synonyms *D. quadridens*, Fabr. Latr.; *D. nodosa*, Coll. du Mus.; *Cancer Frascone*, Herbst. "This *Dorippe* from the East Indies," he adds, "has lately been brought from Manilla by M. Marion de Procé. It so much resembles a species which I have described with doubt as fossil, that I know not how precisely to point out the difference. This species belongs to M. Defrance, who has stated its characters in the article 'Dorippe' (fossil) of the 'Dict. des Sciences Naturelles.'"

DORIS. [NUDIBRANCHIATA.]

DORO'NICUM, a genus of Plants belonging to the natural order *Compositæ*, to the sub-order *Corymbiferæ*, the tribe *Senecionidæ*, and the section *Senecioneæ*. It has the florets of the ray ligulate and pistiliferous; those of the disc tubular, with both stamens and pistils; the involucre hemispherical, of 2 or 3 rows of equal scales; the pappus pilose, wanting in the ray. The species are deciduous herbaceous plants. Two are natives of Great Britain.

D. pardalianches, with cordate denticulate leaves. It has a stem from 2 to 3 feet in height, erect, solitary, hollow, and hairy. It is a rare plant, and found in damp and hilly woods and pastures. It has its specific name from πάρδαλις, a tiger, and ἄγχειν, to strangle, on account of the use said formerly to have been made of the plant for the purpose of destroying wild animals. With the species of *Arnica* and other plants of the order it has the common name of Leopard's Bane.

D. plantaginerum, the second British species, has ovate leaves, and the stem-leaves clasping. It attains about the same height as the last, and its flowers are also yellow. *D. scorpioides*, *D. Caucasicum*, *D. Austriacum*, and *D. pardalianches* are natives of the continent of Europe.

(Koch, *Flora Germanica*; Babington, *Manual of Botany*.)

DORR-HAWK. [GOATSUCKERS.]

DORSATI. [AMMONITES.]

DORSIBRANCHIA'TA, Cuvier's appellation for the second order of Annelides, which have their organs, and especially their branchiæ, distributed nearly equally along the whole of their body, or at least a part. *Chloeia* (Savigny) and *Cirratulus* (Lamarck), with many other genera, belong to this order. [ANNELIDA.]

DORSTE'NIA, a genus of Plants belonging to the natural order *Urticaceæ*. The roots of several species of this genus are all confounded under the appellation of Contrayerva Root; but as they all possess nearly the same chemical composition and properties, it is of little importance which particular species yields what is used. Indeed by the time the root reaches Europe whatever virtues it originally possessed are lost, so that it has scarcely any sensible qualities, and very little effect on the system. It consists of volatile oil, extractive, and starch. The first of these gives it some power over the nervous system, should it not have been dissipated by time. Hence it is recommended in the low stages of fever, especially of children; but Serpentaria Root may at all times be advantageously substituted for it. Contrayerva signifies antidote, and it was at one time supposed to be an antidote to all poisons, whether animal, vegetable, or mineral, except mercury.

DORY. [ZEUS.]

DOTO. [NUDIBRANCHIATA.]

DOTTEREL. [CHARADRIADÆ.]

DOUCKER. [COLYMBIDÆ.]

DOUM. [DOOM.]

DOURA. [SORGHUM.]

DOVES. [COLUMBIDÆ.]

DOWN, the fine hair of plants, is a cellular expansion of the cuticle, consisting of attenuated thin semi-transparent hairs, either simple or jointed end to end, or even branched, as in the Mullein. When attached to seeds, it enables them to be buoyed up in the air and transported from place to place. When covering the external surface of a plant it acts as a protection against extremes of temperature, and probably as a means of absorbing moisture from the air.

DRABA, a genus of Plants belonging to the natural order *Cruciferæ*, the sub-order *Latiseptæ*, and the tribe *Alyssineæ*. It has an oval or oblong pouch, slightly convex, the seeds many in each cell, not margined, in two rows, the filaments simple. The species are perennial or annual branched herbs, with linear oblong or ovate leaves, yellow or white flowers.

D. verna, common Whitlow-Grass, has a leafless scape, glabrous above, with lanceolate acute attenuated leaves, hairy below, the petals deeply cloven, the pouch oblong, shorter than its pedicel. It is an exceedingly common plant, ornamenting old walls and dry banks in the spring before other flowers make their appearance. It is found throughout Europe, and is most abundant in Great Britain. It is the *Erophila verna* of De Candolle.

D. aizoon, Evergreen Whitlow-Grass, has naked smooth scapes, linear acute keeled stiff ciliated leaves, the style as broad as the hairy pod, but one-half shorter. It is a native of Bavaria, Austria, Hungary, Transylvania, and the Carpathian Mountains, particularly on Mount Chocsz.

D. aizoides has a leafless glabrous scape, with linear rigid acute keeled glabrous ciliated leaves, the stamens as long as the slightly-notched petals, the style elongated. It is a native of gravelly soils in almost every country of Europe. It is a rare plant in Great Britain, and has been found on rocks and walls at Penuard Castle, near Swansea. The other British species are—*D. rupestris*, a rare plant found on mountains in Scotland; *D. incana*, also a mountainous species; and *D. muralis*, found on the shady sides of rocks, walls, and mountains, but it is a rare plant in Great Britain.

Above 60 species of *Draba* have been described. They are all insignificant plants inhabiting the temperate and colder parts of the world. They are not often cultivated, but are adapted for rock-work. They are apt to drop off in winter when exposed, and the best way to preserve them is to keep them in pots as other alpine plants. They grow best in a mixture of sand, loam, and peat, and the pots should be well drained with potsherd. They may be propagated by dividing the roots or by seeds.

(Babington, *Manual;* Don, *Dichlamydeous Plants.*)

DRACÆNA, a genus of Endogenous Plants of the natural family *Asparageæ* of Jussieu, now arranged as a section of *Liliaceæ* by Dr. Lindley. The genus was established by Linnæus, and named from one of its species yielding the resinous exudation, familiarly known by the name of Dragon's Blood, a translation of the Arabic name Dum al Akhwain, met with in Avicenna and other Arabian authors. *Dracæna* is characterised by having an inferior 6-partite perianth, of which the segments are nearly erect, and have inserted on them the 6 stamens, with filaments thickened towards the middle and linear anthers. The style is single, with a trifid stigma. The berry 2- or 3-celled, with its cells 1- or 2-seeded.

The species of *Dracæna* are now about 30 in number, and found in the warm parts of the Old World, and in many of both Asiatic and African islands, whence they extend southward to the Cape of Good Hope and Australia, and northward into China, and to the eastern parts of India, as the districts of Silhet and Chittagong. Species are also found in Socotra, and the Canary and Cape Verd Islands, as well as at Sierra Leone. From this distribution it is evident that the species require artificial heat for their cultivation in England. They are found to thrive in a light loam, and may be grown from cuttings sunk in a bark bed.

The species of *Dracæna* are evergreens, either of a shrubby or arboreous nature; and having long slender often columnar stems, they emulate palms in habit. Their trunks are marked with the cicatrices of fallen leaves; the centre is soft and cellular, having externally a circle of stringy fibres. The leaves are simple, usually crowded together towards the end of the branches, or terminal like the inflorescence; whence we might suppose that the name *terminalis* had been applied to some of the species, if Rumphius had not stated that it was in consequence of their being planted along the boundaries of fields. The structure of the stem and leaves is particularly interesting, as the fossil genera *Clathraria* and *Sternbergia* have been assimilated to *Dracæna*, the former by M. Adolphe Brongniart, and the latter by Dr. Lindley; and as Rumphius compares the leaves of a *Dracæna* with those of *Galanga*, it is as probable that the fossil leaves called *Cannophyllites* may be those of a plant allied to *Dracæna*, as that they belong to one of the *Canneæ*.

Of the several species of *Dracæna* which have been described by botanists, there are few which are of much importance either for their useful or ornamental properties. Among them however may be mentioned *D. terminalis*, a species rather extensively diffused. The root is said by Rumphius to be employed as a demulcent in cases of diarrhœa, and the plant as a signal of truth and of peace in the Eastern Archipelago. In the islands of the Pacific Ocean a sweetish juice is expressed from its roots, and afterwards reduced by evaporation to a sugar, of which specimens were brought to Paris by Captain D'Urville from the island of Tahiti (Otaheite). The root is there called Ti or Tii, and thence no doubt corrupted into Tea-Root by the English and Americans. M. Gaudichaud mentions that in the Sandwich Islands generally an intoxicating drink is prepared from this root, to which the name Ava is often applied, as well as to that made with the roots of *Piper methysticum*.

D. Draco is the best known species, not only from its producing Dragon's Blood, but also from one specimen having so frequently been described or noticed in the works of visiters to the Canary Islands. The erect trunk of the Dragon-Tree is usually from 8 to 12 feet high, and divided above into numerous short branches, which terminate in tufts of spreading sword-shaped leaves, pointed at the extremity. The most celebrated specimen of this tree grows near the town of Orotava, in the island of Teneriffe, and was found by Humboldt in 1799 to be about 45 feet in circumference. Sir G. Staunton had previously stated it to be 12 feet in diameter at the height of 10 feet; and Ledru gave even larger dimensions. It annually bears flowers and fruit; and though continuing thus to grow, does not appear much increased in size, in consequence of some of its branches being constantly blown down, as in the storm of July 1819, when it lost a great part of its top. The great size of this enormous vegetable is mentioned in many of the older authors; indeed as early as the time of Bethencourt, or in 1402, it is described as large and as hollow as it is now; whence, from the slowness of growth of Dracænas, has been inferred the great antiquity of a tree which four centuries have so little changed. Humboldt indeed remarks that there can be no doubt of the *Dracæna* of Orotava being, with the Baobab (*Adansonia digitata*), one of the oldest inhabitants of our planet; and as tradition relates that it was revered by the Guanches, he considers it as singular that it should have been cultivated from the most distant ages in the Canaries, in Madeira, and Porto Santo, although it comes originally from India. This fact he adduces as contradicting the assertion of those who represent the Guanches as a race of men completely isolated from the other races of either Asia or Africa. To this it may be replied, that we know too little of the botany of the interior of Africa to be able to draw from it any inferences; while the Dragon-Tree on the other hand is not known to exist farther to the eastward than the island of Socotra.

DRACO. [DRACONINA.]

DRACOCELLA. [DRACONINA.]

DRACONINA, a sub-family of Saurians belonging to the family *Agamidæ*, the tribe *Strobilosaura*, and the sub-order *Pachyglossæ* of Dr. J. E. Gray's arrangement. . The family of Agamas, or *Agamidæ*, is thus defined by Dr. Gray:—"Teeth implanted on the end of the jaws. Tongue short, depressed, apex entire or slightly nicked. Eyelids connivent, valvular. Feet, for walking. Toes all free, unequal; the thumb of the hind feet on the same plane as the other toes; the little toes lower down on the ankle than the thumb. The thumb is anterior and internal, and the great toe of the hind feet occupies the same position, the thigh and foot being bent forwards. This is proved by analogy; this toe being the one that is clawless in the *Gecko*, which have the clawless thumb, and in *Anolis*, where the thumb and great toes are simple, and not dilated beneath, like the other toes."

The synopsis of the genera of this family, according to the 'British Museum Catalogue,' is as follows:—

I. Body compressed. Living on trees.

A. Femoral and pre-anal pores none. Scales imbricate. Asiatic.

a. Ribs elongated, exserted, supporting wing-like lateral expansions. Throat with 3 pouches.

1. *Draco.*—Ears naked. Nostril below the face-ridge.
2. *Dracocella.*—Nostril above the face-ridge.
3. *Dracunculus.*—Ears covered with scales.

b. Ribs simple. Back crested.

* Toes 4 or 5. Ears exposed.

4. *Sitana.*—Males with an elongated pouch. Females without any pouch.

** Toes 5—5. Tail with elongated keeled scales beneath. Scales of back small, often with scattered larger ones.

† Ears hidden under the skin.

5. *Lyriocephalus.*—Head lyrate. Muzzle with a round tubercle in front. Scales unequal.
6. *Ceratophora.*—Head square. Muzzle with a prolonged horn-like process. Scales unequal.
7. *Otocryptis.*—Head squarish. Muzzle nearly flat, simple. Eyebrows bluntly angular behind.

†† Ears exposed.

8. *Gonyocephalus.*—Scales of the belly smooth, of the back unequal. Eyelids angular, produced.
9. *Dilophyrus.*—Scales of the belly smooth; of the back equal. Eyebrow rounded, simple.
10. *Tiaris.*—Scales of the belly keeled, of the back unequal. Eyebrow and parotids unarmed.
11. *Acanthosaura.*—Scales of the belly keeled, of the back unequal. Eyebrows and parotids armed.

*** Toes 5—5. Tail with broad rhombic keeled scales beneath. Scales of back uniform.

12. *Bronchocela.*—Nuchal crest simple. Scales in descending series.
13. *Salea.*—Nuchal crest double. Scales large, in longitudinal series.
14. *Calotes.*—Back crested. Scales in ascending series. Head swollen behind, with one or two ridges of spines.

**** Toes 5—5. Tail with truncated keeled scales beneath. Scales small, keeled, in cross rings.

15. *Chelasonia.*—Parotids swollen, armless. Throat lax. The nape and back with a low crest. Tail rather compressed. Face-ridge rounded, with small scales.
16. *Charasia.*—Parotids swollen, with some spines above. The nape and back with a low crest. Tail tapering. Face-ridge distinct, with enlarged imbricated scales.
17. *Gindalia.*—Parotids rather swollen, with 2 or 3 spines above. Nape and back not crested. Tail tapering, round. Face-ridge indistinct.

B. Femoral pores distinct.

a. Scales rhombic, placed in rings. Toes fringed on each side. Back crested. Throat lax, folded across.

18. *Lophura.*—Back and tail with a fin-like crest, supported by bony rays. Head squarish.
19. *Phrysignathus.*—Back and tail with a crest of compressed scales. Head swollen behind.

b Scales irregular, imbricate. Australian.

* Neck with a frill-like expansion on each side.

20. *Chlamydosaurus.*—Head rhombic.

** Neck simple.

21. *Hatteria.*—Back and tail crested. Head elongate. Pre-anal pores numerous. Scales small.
22. *Lophognathus.*—Back crested. Head elongate. Pre-anal pores 2—2. Femoral pores 2—2.

23. *Diporophora.*—Back keeled. Head short. Pre-anal pores 1—1. Scales rhombic, of belly larger.
24. *Amphibolurus.*—Back crested, with longitudinal series of larger keeled scales. Femoral pores numerous.
25. *Grammatophora.*—Back not crested, with cross rows of larger scales. Femoral pores numerous.

II. Body depressed. Back with imbricate scales. Throat with a cross fold. Terrestrial.

a. Pre-anal pores distinct. Femoral pores none. Ears exposed.

* Pre-anal and abdominal pores in several rows.

26. *Landakia.*—Tail with rhombic keeled scales. Parotids spinose.
27. *Stellio.*—Tail with rings of large spinose scales. Parotids spinose.

** Pre-anal pores in a single line. Abdomen poreless.

28. *Agama.*—Parotids spinose. Scales rhombic, keeled.
29. *Trapelus.*—Parotids unarmed. Scales minute. [AGAMA.]

b. Pre-anal and femoral pores none.

* Ears exposed. Body and limbs with large spinose tubercles.

30. *Moloch.*—Neck with a convex tubercle above.

** Ears hidden. Scales small, granular. Back not crested.

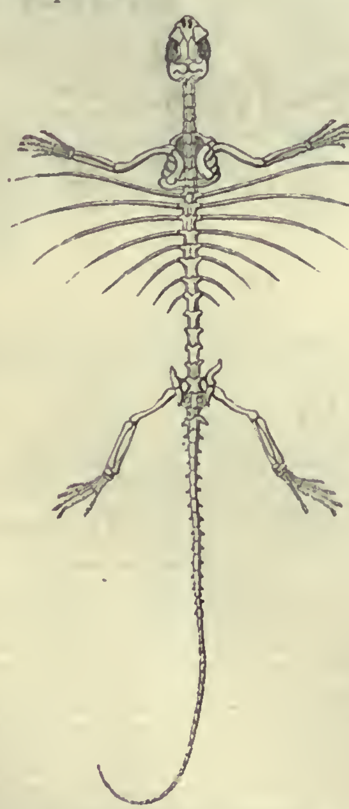
31. *Phrynocephalus.*—Angle of mouth simple. Toes toothed on the sides.
32. *Megalochilus.*—Angle of mouth fringed. Toes fringed on the sides.

c. Femoral pores distinct. Pre-anal pores none. Ears exposed. Scales small, granular. Back not crested.

33. *Uromastyx.*—Tail broad, depressed, with complete rings of spinose scales.
34. *Saara.*—Tail broad, depressed, with scales of the upper part of the rings spinose; of lower, armless.
35. *Leiolepis.*—Tail round, elongate, tapering, with whorls of smooth scales.

The genera and species of the family *Draconina* are as follows :—

1. *Draco.*—Head small. Nostril in a scale, rather tubular on the side of the face-ridge. Tympanum of the ear visible, opaque, white. They live on trees, walking with agility with their wings folded on their sides, but they expand them and use them as a parachute when they throw themselves from the tops of trees. They spread out their pouches as they lie on the trunks of the trees. Scales unequal, some larger, keeled. Nape crested.

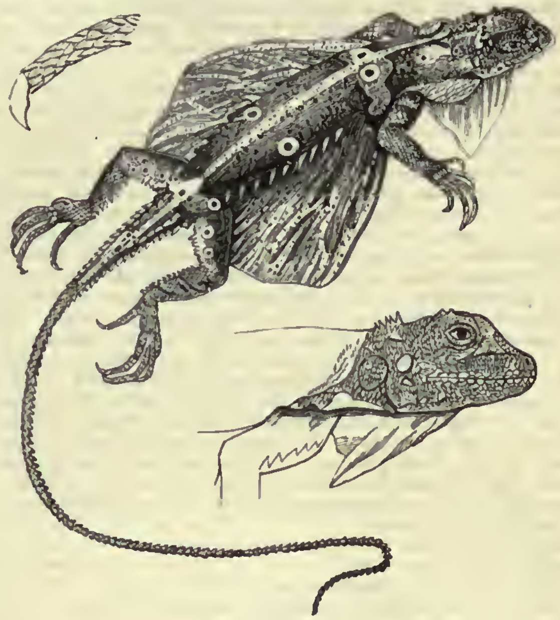


Skeleton of a species of *Draco*.

D. volans, Linn., the Flying Lizard. It is the *D. major* of Lamarck, *D. viridis* of Daudin, *D. Bouroniensis* of Lesson, and the *D. Daudini* of Duméril. The scales of the back are rather broad, generally smooth; of the throat granular, of the same size; the lateral pouches of the males moderate, rounded at the end, covered with ovate keeled scales; the throat black-spotted; wings gray, fulvous, or brown, spotted and marbled with black, sometimes forming four or five oblique black bands near the outer edge: the sides with a series of large broad keeled scales.

D. Timorensis, the Timor Flying-Lizard. It is the *D. viridis Timorensis* of Schlegel. It has flat scales, rather large, smooth, unequal, with a row of rather larger keeled scales upon and on each side of the vertebral line; wings reddish, brown-spotted; lateral pouches (of male) moderate, rounded at the end, covered with large keeled scales; sides with an interrupted series of large keeled scales.

D. fimbriatus, Kuhl, the Fringed Flying-Lizard. Scales of the back small, equal, mostly smooth; the throat with many circular spaces, covered with larger granular scales; head white, brown-netted; lateral pouches of male elongate, angular, acute, covered with large keeled scales; wings with short whitish longitudinal lines; sides with a series of small triangular keeled scales, placed in groups of two or three; nostrils sub-superior.



Draco fimbriatus.

2. *Dracocella.*—Head small, covered with small unequal scales; the nostrils roundish, in a scale, erect, vertical on the face-ridge; tympanum exposed, and opaque.

* Nape crested.

D. Dussumieri, Dussumier's Dragon, has moderate scales, rather rhombic; the sides with a series of rather larger scales, placed in roundish groups; orbit with a small bony point at back and front angle; wings with large brown spots near the body, and largely marbled near the outer edge; a black band across the throat; base of the pouch blue-black; the limbs moderate.

** Nape not crested.

D. Nacuratopogon, the Red-Throated Dragon. The orbit with a small bony point above, upon the front and back edge; scales of the back equal, smooth, the sides with a series of large keeled scales; nape not crested; a large round black spot on each side of the base of the pouch; wings brown-spotted; the limbs elongate.

3. *Dracunculus.*—Head quadrangular, covered with small unequal scales; nostrils lateral, on the face-ridge; tympanum hid under the skin, covered with scales. Weigmann described *D. lineatus* as having but five exserted ribs, but the specimens in the British Museum, like the other dragons, have six on each side.

* Nape not crested, with a longitudinal fold.

D. quinquefasciatus, the Banded Flying-Lizard. Wings with five cross bands; scales of the back keeled; nape with a longitudinal fold, not crested; nostrils superior, erect; ears covered with many equal granular scales.

** Nape crested. Ears slightly concave.

D. lineatus, the Lined Flying-Lizard. Head gray, white-spotted; wings dark-banded, with small white longitudinal lines; the sides and throat bluish-black, with large white spots; the ears indistinctly marked, covered with three flat scales; base of the tail rounder above, with a slight crest on each side.

D. ornatus, the Banded-Head Dragon. Gray; head black, cross-banded; chin black, dotted; wings gray, reticulated with black, and with broad black bands at the edge; scales rhombic, of the middle of the back larger, keeled, of the sides smaller, smooth; ears covered with small equal granular scales; tail slender, compressed, with five keels above and two stronger keels beneath, rather depressed at the base, with five slight keels above.

D. maculatus, the Spotted-Winged Dragon. Gray, black-spotted; wings black-spotted; throat gray; pouch of the male elongate; scales of the back rather unequal, rhombic, keeled, of the sides rather smaller; sides with a series of large keeled scales; ears rather sunk, with unequal flat scales; tail slender, with a central keel above and five more small ones on the sides; base dilated, with five nearly equidistant equal keels above.

D. spilopterus, Weigmann's Flying-Lizard. Wings reddish near the body, with large brown spots, yellow near the edge; throat yellow, black-spotted. This may be the same as the former species, but the wings are subelliptic, and the scales do not exactly agree.

DRACONTIUM (from δράκων, a snake, because the stem is mottled like the skin of a serpent), a genus of Plants belonging to the natural order *Araceæ*. It has a cymbiform spathe, with a cylindrical spadix, quite covered with hermaphrodite flowers, the perianth 7-9-parted; 7-9-stamens, with oblong 2-celled anthers, opening obliquely by a pore at the apex, and distinct from their filaments; the ovary 2-3-celled, each cell containing one pendulous ovule; a 1-3-seeded berry; seeds without albumen.

D. polyphyllum has a tuber resembling a small cake, producing one or two leaves, with long clouded spotted petioles, resembling the skin of a snake. The spathe is large, of a purple colour, very deep inside, hooded, acute, and appearing after the leaves have withered. It smells so powerfully on first expanding, that persons have been known to faint from the stench. It is also said to excite the nerves of hearing, and even induce a state of catalepsy. It is a native of Guyana, Surinam, and other parts of equinoctial America, where it is called Labarri, and regarded as a remedy against the bite of the Labarri Snake, which its spotted leaf-stalks resemble in colour. Its use in this respect is doubtful, but its powerful action on the system might render it available in the treatment of many diseases. There is a species of *Dracontium* in India, called by Ainslie by the same name, which is a valuable remedy in asthma, and is used in hæmorrhoids.

The *Dracontium fœtidum* of Linnæus, the Skunk-Weed and Skunk Cabbage of the United States, is now referred to the genus *Symplocarpus*. It differs from *Dracontium* in its ovaries being 1-celled, and in its spathe being cucullate. It emits a powerful odour. When the tubers are dried and powdered they are used as an antispasmodic in America. It has been recommended in asthma and chronic bronchitis, also in certain cases of hysteria, dropsy, and epilepsy. (Lindley, *Flora Medica*.)

DRACUNCULUS. [DRACONINA.]

DRAGON. [DRACONINA.]

DRAGON-FLY. [LIBELLULIDÆ.]

DRAGON'S-BLOOD. [CALAMUS; DRACÆNA.]

DRAGON-TREE. [DRACÆNA.]

DRAGONET. [CALLIONYMUS.]

DRAKÆA, a genus of Plants belonging to the natural order *Orchidaceæ*. *D. elastica* has a single flower placed at the end of a slender smooth erect scape from 12 to 18 inches long, and its labellum, which is hammer-headed and placed on a long arm with a moveable elbow-joint in the middle, is stated by Mr. Drummond to resemble an insect suspended in the air and moving with every breeze.

DREELITE, a Mineral, found at Nuisière, near Beaujeu, France, occurs crystallised. Its primary form is a rhomboid, without any modifications. It presents three cleavages parallel with the faces of the primary crystal. Its colour and streak are white. Its hardness 3·25. Its lustre pearly. Its specific gravity 3·2 to 3·4. The following is an analysis by Dufrénoy:—

Sulphate of Barytes	61·731
Sulphate of Lime	12·274
Carbonate of Lime	8·050
Lime	1·521
Silica	9·712
Alumina	2·404
Water	2·308
	—— 98.

DRILL. [BABOON.]

DRIMYS. [WINTERA.]

DRIZZLE. [LOTA.]

DROMEDARY. [CAMELUS.]

DRO'MIA (Fabricius), a genus of Brachyurous Decapod *Crustacea*, placed by M. Latreille in the section of *Notopoda*, and referred by Dr. Leach to the family of *Thelxiopoda*. In the 'British Museum Catalogue' they are referred to the order *Anomoura* and the family *Dromiadæ*.

It has the following characters:—External antennæ small, inserted below the ocular peduncles; the intermediate antennæ placed below and a little within the eyes; external jaw-feet with their third joint nearly square, slightly notched at the extremity and within; claws (chelæ) great and strong; feet of the second and third pair terminated by a simple joint, and larger than those of the fourth and fifth pair, which are elevated on the back and provided with a claw, inasmuch as the last joint, which is bent and pointed, is opposed to a spine nearly of the same form, which terminates the penultimate joint; carapace oval, rounded, very convex, cut (découpée) on its anterior borders, hairy or rough (hérissée), as well as the feet and chelæ; eyes small, supported on short peduncles, rather approximated, and lodged in orbicular or cylindrical fossæ. (Desmarest.)

The species are found in the seas of warm climates. They are indolent in their motions, and live in spots where the sea is moderately deep, choosing for their habitation places where the rocks are not hidden under the sand. They are almost always found covered with a species of *Alcyonium*, or with valves of Conchifers, which they retain with their four hinder feet, and which seems to serve them as a shield against their enemies. The *Alcyonia*, which are in general of the species named *Alcyonium Domuncula*, continue even to develop and extend themselves upon their carapace, which they at last entirely conceal. In the month of July, according to M. Risso, the females come out of the state of torpor (engourdissement) in which they ordinarily are, and betake themselves to the shallows for the purpose of depositing there a great number of eggs. (Desmarest.)

Dynomene, according to Desmarest, should be placed next to *Dromia*, the former differing from the latter principally in having the feet of the fifth pair only instead of the last four elevated on the back. In general the *Dromiæ* bear a great resemblance to the Crabs, properly so called, in the general form of the body, the structure of the parts of the mouth, the position of the antennæ, &c.; but they differ from them in the elevated situation of their four posterior feet and in their manners.

Dromia hirsutissima. Carapace very convex, with six dentations on its lateral borders, and with a large sinus on each side of the front, which is nearly trilobated. Body covered with long red hairs. It is a native of the Cape of Good Hope.

Dromia hirsutissima.

The other species, of which there are specimens in the British Museum, are—*D. vulgaris*, Mediterranean; *D. Rumphii*, Japan; *D. Indica*, Indian Ocean; *D. fallax*, Mauritius; *D. verrucosipes*, Philippine Islands.

DRONE. [BEE.]

DRONTE. [DODO.]

DROPWORT, a poisonous wild Umbelliferous Plant, with fleshy-fingered roots, inhabiting ditches and wet places. It has been sometimes sold fraudulently by itinerant gardeners as a new species of dahlia. Its botanical name is *Œnanthe crocata*.

DRO'SERA (from δρόσος, dew), a genus of Plants belonging to the natural order *Droseraceæ*. It has a calyx deeply 5-cleft; 5 petals; 5 stamens; 3-5 styles, deeply bifid; a many-seeded 1-celled capsule, with 3-5 valves. The species are herbs inhabiting bogs and mossy swamps. The leaves are furnished with reddish glandular hairs, which discharge from their point a viscid acrid fluid. Insects are often caught upon these hairs, and hence they have been supposed to be irritable, and to resemble those of the *Dionæa muscipula*, Venus's Fly-Trap, a plant belonging to the same order.

D. rotundifolia, Common or Round-Leaved Sun-Dew, has orbicular spreading leaves, hairy petioles, erect peduncles, seeds with a loose chaffy coat. This plant is a native of Europe, in boggy places especially where the Sphagnum grows. It is found in Great Britain, and has many localities near London, especially Wimbledon Common and Hampstead Heath. It is employed in Italy for making the liqueur called Rossoli. It is an acrid and caustic plant, and has been supposed to cause rot in sheep. It curdles milk, and has a reputation for removing corns, bunions, and warts. When distilled with wine a stimulating spirit is procured, which was formerly much used as an excitant.

D. lunata has viscid leaves with glandular fringes, which close upon flies and other insects that happen to alight upon them. It is probable that it would yield a valuable dye. It is also believed that some of the species of *Drosera* found near Swan River, in Western Australia, might be turned to accouut in that way, for every part of *D. gigantea* stains paper of a beautiful purple colour; and when fragments are treated with ammonia they yield a clear yellow.

Two other species, *D. longifolia* and *D. Anglica*, are natives of Great Britain. The first is a common bog-plant, but the latter is only common in the British Islands in Ireland. About 40 species of this genus have been described. They have been found in boggy places in all parts of the world, except in the extremes of heat and cold. They are all singularly beautiful and worthy of cultivation. They thrive best in small pots, which should be three-parts filled with peat-earth, and Sphagnum should be planted on it; the Droseras should be planted iu the moss, and the pots placed in pans of water. The Australian and Cape of Good Hope species will require the stove. They may be propagated by seeds, but foreign plants should be brought over in cases, for which purpose those of Mr. Ward are admirably adapted.

Don, *Dichlamydeous Plants;* Loudon, *Encyclopœdia of Plants.*)

DROSERA'CEÆ, *Sun-Dews*, a natural order of Albuminous Exogenous Plants, consisting of marsh herbs whose leaves are usually covered with glands or glandular hairs, and whose flowers are arranged in circinate racemes. The calyx consists of 5 sepals: there are 5 petals; 5 or 10 hypogynous stamens; a 1-celled many-seeded capsular fruit; and minute seeds, having an embryo lying at the base of a large quantity of albumen. There are many species of the genus *Drosera*, called in England Sun-Dews, more remarkable for the singular structure of their glandular hairiness than for the beauty of their flowers. A few other little known genera are associated with it; and it is probable that *Dionœa* [DIONÆA], whose singular irritable leaves have much analogy with those of *Drosera*, also forms a part of the order, notwithstanding its indehiscent fruit and erect vernation.

De Candolle having inexactly described the embryo as lying in the axis of the albumen, the true affinities of the order were overlooked; they have since however been more correctly determined to be with *Cephalotaceœ* and *Francoaceœ* rather than with *Violaceœ, Polygalaceœ,* or *Frankeniaceœ.*

Round-Leaved Sun-Dew (*Drosera rotundifolia*).

1, a complete flower magnified; 2, a ripe capsule magnified—the seeds are seen between the valves of the capsule; 3, a seed very much magnified—the dark space in the middle is the nucleus, the remainder is a loose integument that invests the seed; 4, a section of the nucleus still more magnified—here the minute dicotyledonous embryo is seen at the base of the albumen.

DRUPA'CEÆ, the name given by some botanists to that division of Rosaceous Plants which comprehends the Peach, the Cherry, the Plum, and similar fruit-bearing trees. They are more generally called *Amygdaleæ.* [AMYGDALEÆ.]

DRUPE, a close 1-celled, 1- or 2-seeded seed-vessel, whose shell is composed of three layers; the outer membranous or leathery, the inner hard and bony, the intermediate succulent or fibrous. A peach, a cherry, a mango, are all fruits of this description. A cocoa-nut is a Compound Drupe, being composed of three consolidated carpels, two of which are abortive; and a date is a Spurious Drupe, the hard inner shell being represented by a membrane. In theory the stone or inner bony layer of the shell is equivalent to the upper side of a carpellary leaf, the external membrane to the lower surface, and the intermediate pulp or fibre to the parenchyma.

DRYANDRA, a genus of Australian Shrubs belonging to the natural order *Proteaceœ*, with hard dry evergreen serrated leaves, and compact cylindrical clusters of yellow flowers, seated upon a flat receptacle, and surrounded by a common imbricated involucre. It is in the latter respect that the genus principally differs from *Banksia*. The species are much esteemed by cultivators for their beautiful evergreen leaves. They are commonly regarded as greenhouse plants, but will in several cases survive an English winter without injury, if protected by a glass roof in winter, and planted among rock-work high above the dampness of the level of the soil.

DRYAS, a genus of Plants belonging the natural order *Rosaceœ*, and to the tribe *Dryadeœ*. It has the calyx 8-9-cleft, in one row; 8-9 petals; numerous stamens; the fruit composed of numerous small nuts, tipped with the persistent hairy styles, which are straight at the extremity, and aggregated on a dry receptacle; the seeds ascending. The species are herbs or under-shrubs, with the stipules adnate to the sides of the petioles.

D. octopetala has crenate-serrate obtuse leaves; the sepals three or four times as long as broad, more or less pointed; the base of the calyx hemispherical. The plant has white flowers, with a woody prostrate stem and simple leaves with a woolly pubescence beneath. It is a native of alpine districts of Europe, and is found iu the mountains of Scotland and Ireland, and in Yorkshire in England.

D. depressa has crenate-serrate obtuse leaves, the sepals twice as long as broad, and blunted and rounded at the end, the base of the calyx truncate and nearly flat. This species has only been found at Ben Bulben, in Sligo, and has been described by Babington in the 'Annals of Natural History.' Three other species have been described, one a native of Greenland, aud two natives of North America. They are all evergreen prostrate plauts. When cultivated they thrive best in a border of peat soil. They may be propagated by dividing the roots, or by seeds. They may be also planted in pots as other alpine plants.

(Babington, *Manual of British Botany;* Don, *Dichlamydeous Plants.*

DRYOBA'LANOPS, a genus of Plants belonging to the natural order *Dipteraceœ*, established by the younger Gærtner from specimens of the fruit found in the Banksian collection, supposed by him to belong to the tree which yielded the best cinnamon; but Mr. Colebrook, from specimens sent to Dr. Roxhurgh, which in the absence of the latter he received, ascertained that the fruit belonged to the Camphor-Tree of Sumatra, which he accordingly named *Dryobalanops camphora*, "until its identity with *D. aromatica* (of Gærtner) be established." ('Asiat. Researches,' xii.) Dr. Roxhurgh had, in his manuscript 'Flora Indica,' already named it *Shorea camphorifera.* Some botanists are of opinion that the genus is not sufficiently distinguished from *Dipterocarpus;* but Blume, tho latest author, and one who has had the fullest opportunity of examining the subject, has, in the article on *Dipterocarpeœ* in his 'Flora Javæ,' given it as his opinion that *Dryobalanops* should be kept distinct; as, like *Shorea*, it has all five instead of only two of its sepals prolonged into long foliaceous wings, while its cotyledons are unequal and rumpled.

According to Blume the existence of this camphor-yielding tree was first indicated by Grimm in 'Ephem. Nat. Cur.' Kæmpfer was so well acquainted with its distinctness that in describing the Camphor-Treo of Japan (*Laurus camphora*) he says, "that natural camphor of crystal-like appearance, which is scarce and of great value, is furnished by a tree of Borneo and Sumatra, which is not of the Laurel genus." The first notice of the treo is in the 4th volume of the 'Asiatic Researches,' where we learn that a tree named Tappanooly on the west coast of Sumatra yielded above three pounds of camphor, and at the same time nearly two gallons of camphor-oil; that the tree resembles the bay in leaves, is fond of a rich red loam tending to a blackish clay, and that it grows priucipally on the north-west coast of Sumatra, from the Line to 3° N. lat. The fullest account is given by Mr. Prince, resident of Tappanooly, who describes the tree as growing spontaneously in the forests, and as being found in abundance from the back of Ayer Bongey as far north as Bacongan, a distanco of 250 miles: he says that it may be classed among the tallest and largest trees that grow on this coast, several within daily view measuring 6 or 7 feet in diameter; but it will produce camphor when only 2½ feet in diameter. The same tree which yields the oil would produce camphor if unmolested, the oil being supposed to be the first state of the secretion, which ultimately changes into concrete camphor, as it occupies the same cavities in the trunk which the camphor afterwards fills; consequently it is found in young trees. The produce of camphor of a middling-sized treo is about eleven pounds, and of a large one double that quantity. ('Fl. Ind.' ii., p. 616.) This kind of camphor is very highly esteemed by the Chinese. It is commonly called Malay Camphor, or Camphor of Barus, from the port of Sumatra, wheuce it is mostly shipped. Its price in China is one hundred times greater than that of the common camphor of commerce. (M'Culloch, 'Com. Dict.') In the same work it is mentioned that camphor-oil being nearly as cheap as spirits of turpentine, might perhaps be profitably imported into England as a substitute for that article, or for medicinal use.

Camphor, which in many respects resembles the essential oils, has been shown by Dumas to be an oxide of hydrocarbon, indentical in composition with pure oil of turpentine: hence the term Camphene has been applied to it. But Dr. Thomson informs us that its camphor-oil differs in some respects from camphene, as he was not able to produce camphor with the same facility or in equal quantity by driving a stream of oxygen gas through highly-rectified oil of turpentine, which Dumas regards as pure camphene.

DRYOPS, the name given by Olivier to a genus of Pentamerous Coleopterous Insects of the family *Claricornes*. The type is the *Dermestes auriculatus* of Geoffroy, a little oblong gray sluggish beetle, not uncommon in Europe in the neighbourhood of watery places. Fabricius changed the name of this genus into *Parnus*. It includes 14 species, of which 7 are American and 7 European. The name *Dryops* was applied by Fabricius to another genus of *Coleoptera*, of which the *Œdemera femoralis*, a Swiss insect, was the type. Changes of this kind are highly censurable, increasing as they do the confusion arising from a complicated synonymy.

DRY ROT, a well-known disease affecting timber, and particularly the oak employed for naval purposes. When dry rot is produced by the attacks of fungi, the first sign of it consists in the appearance of small white points, from which a filamentous substance radiates parallel with the surface of the timber. This is the first stage of growth of the spores of the fungus, and the filamentous matter is their thallus or spawn. As the thallus gathers strength it insinuates its filaments into any crevice of the wood, and they, being of excessive fineness, readily pass down and between the tubes from which the wood is organised, forcing them asunder, and completely destroying the cohesion of the tissue. When the thalli of many fungi interlace, the radiating appearance can no longer be remarked; but a thick tough leathery white stratum is formed wherever there is room for its development, and from this a fresh supply of the destructive filamentous thallus is emitted with such constantly increasing rapidity and force, that the total ruin of timber speedily ensues where circumstances are favourable for the growth of the fungi.

It is generally stated that dry rot consists of the thallus of *Merulius lacrymans*, or *Polyporus destructor*, two highly-organised fungi, whose fructification is sometimes found upon rotten timber. But it is a great mistake to suppose that dry rot belongs exclusively to those two species, or that they are even the common origin of it: on the contrary, there is reason to believe that any of the fungi that are commonly found upon decaying trees in woods are capable of producing dry rot, and it is quite certain that one of the most rapidly-spreading and dangerous kinds is caused by the ravages of different species of *Sporotrichum*. The latter throw up from their thallus whole forests of microscopic branches loaded with reproductive spores, of such excessive smallness that they may insinuate themselves into the most minute crevices or flaws even in the sides of the tubes of which timber consists, and they are infinitely more dangerous than *Merulii* or *Polypori*, which seldom fructify.

The circumstances that are most favourable to the development of the dry rot fungi are damp, unventilated situations, and a subacid state of the wood. The latter condition, especially in oak, is easily produced by a slight fermentation of the sap which remains in the timber, especially if the latter has not been well-seasoned before being employed. It has been proved experimentally that fluids which, in their ordinary state, will not produce fungi, generate them abundantly if ever so slightly acidulated. Dutrochet found that distilled water holding in solution a small quantity of white of egg will not generate fungi in a twelvemonth, but upon the addition of the minutest quantity of nitric, sulphuric, muriatic, phosphoric, oxalic, or acetic acid, it generated them in eight days' time in abundance. Alkalescent infusions possess the same property. This observer states that the only poisons which will prevent the appearance of fungi are the oxides or salts of mercury. A solution of fish-glue yields fungi rapidly and in great abundance; but a small quantity of red precipitate or corrosive sublimate destroys this power entirely. It is moreover an important fact that no other mineral preparation has any such properties. Dutrochet ascertained that other metallic oxides acted differently. Oxides of lead and tin hastened the development of fungi; those of iron, antimony, and zinc, were inert; and oxides of copper, nickel, and cobalt, although they retarded the appearance of fungi, yet did not prevent their growth in the end. These facts are confirmed by the experience of the use of Kyan's process for preparing timber, which consists in submitting the wood to the action of corrosive sublimate. Immersing the wood in chloride of zinc also prevents the attack of fungi, and also submitting it to the action of the vapour of creasote.

Dry rot also occurs in animals. Specimens of hymenopterous insects resembling wasps have been brought from the West Indies, with a fungus allied to *Sphæria militaris* growing from between their anterior coxæ, and it is positively asserted by travellers that the insects fly about while burdened with the plant. Upon opening the bodies of the wasps they are found filled with the thallus of the fungus up to the orbits of the eyes and the points of the tarsi; the whole of the intestines being obliterated. In such cases it is to be supposed that the thallus of the *Sphæria* first kills the wasp by compressing and drying up the body, and then, continuing to grow, occupies the whole of the cavity of the shell of the insect. A more common instance of animal dry rot is the disease in silkworms called La Muscadine. Silkworms of all ages are occasionally liable to become sickly and to die, soon after death becoming stiff, and acquiring such a degree of firmness as to be readily broken. They then throw out from their surface a sort of white efflorescence, which is the fructification of the fungus called *Botrytis Bassiana*, their inside being filled by the thallus of the same plant. If some healthy caterpillars are placed beneath a bell-glass, along with a small portion of worm killed by the *Botrytis*, they soon catch the disease, exhibit the same symptoms as those already mentioned, and eventually perish; having, no doubt, been infected either by rubbing themselves against the dead worm, or, which is more probable, having received upon their skins the infinitely minute seeds dispersed by the *Botrytis*. If healthy crysalids are inoculated by the introduction below their shell of a little of the *Botrytis* matter upon the point of a needle, they also sicken and die.

In these cases effects are produced upon insects similar to those upon timber; that is to say, vitality in the one case and cohesion in the other is destroyed by the growth of the thallus of certain fungi, which spread with great and irresistible rapidity, and fructify where occasion offers.

For other instances of the agency of fungi in producing the destruction of vegetable and animal tissues, see FUNGI.

DSHIKKETEI (*Zikketei*). Cuvier writes the word *Dziggu̇etai*, and Buffon *Dzigithai*, the native name for the *Eques Hemionus* of Pallas, *Asinus Hemionus* of Gray. [EQUIDÆ.]

DUCK-BILL. [ORNITHORHYNCHUS.]

DUCKS, *Duck Family*, *Anatidæ*, a family of Birds belonging to the order *Natatores*, *Anseres*, or *Palmipedes*. They are all Aquatic Birds, and have webbed feet.

Willughby distinguishes the whole-footed birds with shorter legs into such as want the back toe, and such as have it; these latter into such as have all four toes webbed together, and such as have the back toe loose or separate from the rest; these latter again he subdivides "into narrow-billed and broad-billed; the narrow-billed have their bills either hooked at the end, or straighter and sharp-pointed. The hook-billed have their bills either even or toothed on the sides. Those that have straighter and sharp-pointed bills are either short-winged and divers, called Douckers and Loons, or long-winged and much upon the wing, called Gulls. The broad-billed are divided into the Goose kind and the Duck kind. The Duck kind are either Sea-Ducks or Pond-Ducks." He afterwards, in his section on the Broad-Billed Birds of the Duck kind, thus treats (chap. i.) of the Duck in general:—"The Duck kind have shorter necks and larger feet in proportion to their bodies than Geese: lesser bodies. Howbeit, the biggest in this kind do equal if not exceed the least in that. They have shorter legs than Geese, and situate more backward, so that they go waddling; a broader and flatter back, and so a more compressed body; and lastly, a broader and flatter bill. Their tongue is pectinated or toothed on each side, which is common to them with Geese.

"These are of two sorts, either wild or tame. The wild again are of two sorts—1. Sea-Ducks, which feed mostwhat in salt water, dive much in feeding, have a broader bill (especially the upper part) and bending upwards (to work in the slem), a large hind toe, and thin (likely for a rudder), a long train, not sharp-pointed. 2. Pond-Ducks, which haunt plashes, have a straight and narrower bill, a very little hind toe, a sharp-pointed train, white belly, speckled feathers, black with glittering green in the middle wing, with a white transverse line on either side. For this distinction of Sea-Ducks and Pond-Ducks we are beholden to Mr. Johnson."

Ray divides his 'Palmipedes latirostræ minores, seu Anatinum genus' into *Anates marinæ* and *A. fluviatiles, aquas dulces præcipuè frequentantes*, *A. exoticæ Brasilienses*, and *A. domesticæ*. Brisson's 24th order, consisting of birds with four toes, the three anterior being joined together by membranes, the posterior separated, and with a dentilated bill, includes the genera Harle, Oie, and Canard (Goosanders, Geese, and Ducks). This order is placed between that order of birds the arrangement and connection of whose toes is similar to the modifications of those parts in the 24th order, but which have a bill without dentilations (Puffins, Petrels, Gulls, Terns, &c.), and the 25th order, which is distinguished by the birds arranged under it having all the toes joined by membranes (the Darters, Boobies, Pelicans, &c.).

Linnæus, under his third class of birds, *Anseres*, included the genera *Anas*, *Mergus*, *Alca*, *Procellaria*, *Diomedea*, *Pelecanus*, *Plotus*, *Phäeton*, *Colymbus*, *Larus*, *Sterna*, and *Rynchops*; in short, all those birds which possess a rather blunt bill, covered with an epidermis, gibbous at the base, dilated at the apex, and with denticulated fauces, a fleshy tongue, and palmated natatorial feet. The class stands between the *Picæ* and the *Grallæ*. The genus *Anas* comprehends the Swans, the Geese, and all the Ducks in the general acceptation of the term.

Pennant's 24th genus, Duck, is placed between the genus Merganser (Goosander) and the genus Corvorant; and it comprehends the Swans, the Geese, and all the Ducks, like the Linnæan genus *Anas*.

Latham, who divides the birds into terrestrial and aquatic, makes his 9th order, *Palmipedes*, consist of two great sections—the first consisting of those with long feet—Avoset and Flamingo for example —and the second of those with short feet, comprehending all the short-limbed aquatic birds with webbed feet.

Lacépède's second sub-class of birds consists of those the lower part of whose legs is denuded of feathers, or have many toes united by a membrane. The first division of this sub-class consists of those which have three anterior toes and one posterior toe, or none. The first sub-division consists of the Water-Birds (Oiseaux d'Eau); and the 23rd order of Lacépède comprehends those genera which have a dentilated bill, namely, Canard, *Anas;* Harle, *Mergus;* Priom, *Prion.* The genus *Anas* consists of all the birds which combine with the characters above stated a wide bill, rounded at its extremity, and furnished around the mandibles with small vertical laminæ.

Cuvier's 6th and last order is the Palmipèdes; and the last family of that order, Lamellirostres, contains the great genus Des Canards (*Anas*, Linn.). Cuvier remarks that they are commonly divided into three sub-genera, the limits of each of which are not very precise, namely, the Swans (*Cygnus*, Meyer), the Geese (*Anser*, Brisson), and the Ducks, in the general acceptation of the term (*Anas*, Meyer). The other great genus of Cuvier's Lamellirostres is *Mergus*, Linn.

Cuvier separates the genus *Anas* into two divisions. The first consists of those whose hind toe is bordered by a membrane, whose head is larger and neck shorter in comparison, and which have also the feet placed more backwards, the wings smaller, the tail stiffer, the tarsi more compressed, the toes longer, and the webs more entire. They walk badly, live more exclusively upon fishes and insects, and dive more frequently. (*Platypus*, Brehm; *Hydrobates*, Temminck; *Fuligula*, Carlo Bonaparte). This first division contains the following sub-divisions: Les Macreuses (*Oidemia*, Fleming, *Anas nigra*, *A. fusca*, Linn., &c.); Les Garrots (*Clangula*, Leach; *A glacialis*, *A. histrionica*, Linn., &c.); Les Eiders (Eider-Ducks, *Somateria*, Leach, *A. mollissima*, Linn.); Les Millonins (*Fuligula*, Leach).

The second division is formed by those Ducks which are without the membranous border on the hind toe, and have the head smaller, the feet less, the neck longer, the bill more equal, and the body less clumsy (épais). These walk better, and seek aquatic plants and their seeds as much as fish and other animals. It would seem, adds Cuvier, that the swellings of their tracheæ are of a homogeneous bony and cartilaginous substance. It is to this division that Carlo Lucien Bonaparte, prince of Canino, confines the appellation *Anas*. The following are the sub-divisions:—Les Souchets, *Rhynchaspis*, Leach; Les Tadornes, *A. tadorna*, Linn., &c.; those which have naked parts about the head, and often a boss or convexity on the base of the bill, as the Muscovy Duck; those with a pointed tail, *A. acuta*, Linn., for instance; those whose male has curled feathers in the tail, as the Wild Duck, *Boschas*, *A. Boschas*, Linn.; those which have a tuft on the head, and the bill rather narrower anteriorly, as the Summer-Duck, *Anas sponsa*, Linn., and the Mandarin-Duck, *A. galericulata*, Linn., *Dendronessa*, Swainson; those which have the bills of ducks, but legs even longer than those of the geese, and which perch and nestle in trees, *A. arborea*, Linn., &c. One of these Cuvier observes has the feet only semipalmated, *A. semipalmata*, Latham. Finally, Cuvier goes on to state that we possess, especially in winter, among those which have nothing remarkable about them, *A. strepera*, Linn., *A. Penelope*, Linn.; and many small species which are distinguished by the name of Sarcelles, Teals, *A. querquedula*, Linn., the Common Teal, for example.

Mr. Vigors, in his paper 'On the Natural Affinities that connect the Orders and Families of Birds,' read before the Linnæan Society, December 3, 1823 ('Trans. Linn. Soc.' vol. xiv. p. 395), makes his 5th order *Natatores* consist of the families stated in the article COLYMBIDÆ. The family of *Anatidæ* (Leach), to which he leads his readers from the preceding order (*Grallatores*) by means of the connection between the *Rallidæ* and *Cereopsis*, consists, he observes, of the groups which compose the Linnæan genera *Anas* and *Mergus*, and with respect to the affinities that prevail throughout the families of the order, he remarks that the more extensive subdivisions of the Linnæan *Anas* which have been acknowledged by all systematic writers, either under the name of sections or genera, display in conjunction with *Mergus* a regular series of affinities conformable to the principles advanced by him as regulating the order. The first group, he observes, upon which we enter in this first aberrant family of the order, has been formed into a sectional subdivision by M. Temminck, under the denomination of Les Oies; and with equal signification and more effect has been made into a genus, under the title of *Anser*, by M. Illiger, who therein followed the older naturalists that preceded Linnæus. These birds retain much of the manners of the Waders. They are endowed with considerable facility in walking, are found to swim but seldom, and do not dive at all. In these characters, as well as in other particulars, they correspond with the family of *Laridæ*, which meets them at the other extremity of the circle of *Natatores*.

To this division succeeds *Cereopsis*, Latham [CEREOPSIS], strongly allied to the preceding *Anseres* by its general structure, but still more typical in the family in consequence of the length and nakedness of the tarsi above the knee: characters which indicate a greater power of walking, and a greater deficiency in swimming. It joins the third division, or the genuine *Anates*, by means of a group of which *Anas arborea*, Linn., is the representative. This third and most typical group of the family, which accords with M. Temminck's first section of 'Canards proprement dits,' still approaches more closely to the land birds than the birds which follow: the species swim with ease, and even dive, but the latter faculty they seldom exercise unless when pursued. Their food is also less exclusively marine than that of the succeeding groups, being composed of vegetables, grains, and insects, in addition to fish. This division, consisting of many prominent forms, of which *Anas arborea* before mentioned, *A. tadorna*, *Boschas*, *clypeata*, *Penelope*, and *querquedula* may be considered types, is distinguished from the remainder of the 'Canards proprements dits' of M. Temminck by the hind toe being entire, or free from the lobated membrane which is attached to the hind toe of these last. Mr. Vigors proceeds to state that this character of the lobated membrane, which is of considerable importance as pointing out the approach of the birds in which it is found to the more typical oceanic families, prevails in all the remaining groups of the present family. It is strongly conspicuous in *Mergus*, Linn., the next division that appears to follow: and we consequently find that the species of that genus carry the powers of swimming and diving to the greatest extent, making use of their wings also in their progress through the water; and at the same time exhibiting a constrained and embarrassed mode of walking, in consequence of the backward position of the legs. It thus forms the passage to the succeeding family of *Colymbidæ*. In the shape of its bill, which is slender and partially compressed, it exhibits a distinct form in its own family: but still, by means of the bill of an intervening species, *M. albellus*, Linn., which is intermediate in its breadth and depression, it preserves its connection with the *Anates*. "We hence," continues Mr. Vigors, "pass to the 5th and last group of the family which, with the bill of the *Anates*, retains most of the characters conspicuous in *Mergus*. The forms most prominent in it, represented by the different Linnæan species *Anas ferina*, *clangula*, *histrionica*, and *mollissima*, possess a strongly lobated hind toe; they frequent the ocean for the most part, where they dive with the greatest facility and for a length of time; and they live chiefly on marine animals. Their legs are also thrown behind the equilibrium of their body; and thus also they evince their contiguity to the typical *Natatores*. By means of the group which contains *A. mollissima*, our well-known Eider-Duck and its congeners, where the bill, with an elevated protuberance at the base, approaches that of the *Anas olor*, Linn., we find ourselves brought round to the *Cygnus* of the present day, which forms part of the first division. That genus in like manner deviates partially from the conterminous genus *Anser*, in its legs being thrown more backward, and its consequently greater awkwardness in walking. Here then the affinities are evident which thus establish the perfect return of the series of the *Anatidæ* into itself. Before we leave the family I must indulge myself in observing a most conspicuous peculiarity which marks the series of affinities among these groups. The long and slender neck observable in the *Grallatores* is preserved in such groups of the *Anatidæ* as are most conterminous to that order, such as *Cygnus*, *Anser*, *Bernicla*, and *Cereopsis*, until it is superseded by the short necks of the more Oceanic *Anatidæ*, which exhibit all the expansion and capaciousness of throat observable in the typical *Natatores*."

In the 'Zoological Journal' (vol. ii.), Mr. Vigors gives a disposition of the *Anatidæ*, which exhibits a slight deviation from that drawn out in his paper referred to above. The following is the arrangement.

ORDO V. *Natatores*, Ill. (*Anseres*, Linn.)

1. Family *Anatidæ*, Leach. (Gen. *Anas Mergus*, Linn.)

*

Sub-Family *Anserina*.

Anser, Briss.; *Bernicla*, Steph.; *Cheniscus*, Brookes's M.M.S.; *Chenoplex*, Steph.; *Plectropterus*, Leach.

* *

Sub-Family *Cereopsina*.

Cereopsis, Lath.

* * *

Sub-Family *Anatina*.

Tadorna, Leach; *Cairina*, Flem.; *Anas*, Auct.; *Dafila*, Leach; *Mareca*, Steph.; *Querquedula*, Ray; *Rhynchaspis*, Leach.

* * * *

Sub-Family ?

Clangula, Flem.; *Harelda*, Ray; *Mergus*, Linn. (*Merganser*, Briss.); *Somateria*, Leach; *Oidemia*, Flem.; *Biziura*, Leach.

* * * * *

Sub-Family *Cygnina*.

Cygnus, Meyer.

The other four families are—2. *Colymbidæ*, Leach; 3. *Alcadæ;* 4. *Pelecanidæ*, Leach; 5. *Laridæ*, Leach.

Mr. Yarrell in his 'Observations on the Tracheæ of Birds' ('Linn. Trans.' vol. xv.), after speaking of the form of the windpipe, among others of the Black Swan of Australia, *Anas atrata*, Linn., and of that of the Semi-palmated Goose, *Anas semipalmata* of Dr. Latham, goes on to remark that the different species of geese considered British present nothing remarkable in their tracheæ, the Egyptian Goose alone excepted, the male of which species possesses a bony enlargement at the bottom of its windpipe; and he notices the circumstance that systematic authors seem to agree in placing this bird at the bottom of the list of the geese, where it appears to occupy its proper situation; and observes that, combining as it does some of the characters common to those birds and the true ducks, it becomes a very natural link between them, and he closes his interesting paper with an arrangement of the British species of the latter portion of this family founded upon internal as well as external conformation.

"The first division of true ducks," says Mr. Yarrell, "will contain the Shieldduck, Muscovy Duck, Wild Duck, Gadwall, Shoveler, Pintail, Wigeon, Bimaculated Duck, Garganey, and Teal, all of which will be found to have the following characters in common. Externally they exhibit considerable length of neck; the wings are also long, reaching to the end of the tail; the tarsi somewhat round; the hind toe free or having no pendent lobe. In habits they may be stated generally as frequenting fresh water, but passing much of their time on land, feeding in ditches and about the shallow edges of pools on aquatic plants, insects, worms, and occasionally fish, taking their food at or near the surface; possessing great powers of flight, but seldom diving unless pursued. Of their internal soft parts, the stomach is in the greatest degree muscular, forming a true gizzard; the intestines long, the cæcal appendages from 6 to 9 inches in length in the larger birds, and decreasing only in proportion to the size of the species. Of the bones it may be observed that the ribs are short, extending but little beyond the line of the posterior edge of the sternum; the keel of the breast-bone deep, affording great extent of surface for the insertion of large and powerful pectoral muscles; the enlargement at the bottom of the trachea in all of them is of bone only. The wild duck may be considered the type of this division."

Mr. Yarrell then proceeds to state that the Eider-Duck, King-Duck, Velvet-Duck, and Scoter, possessing some characters common to the preceding class, and others belonging to that next in succession, appear to supply the link between these two divisions; and he regrets that the extreme rarity of the last-named species had prevented him from making any examination beyond that afforded by the external parts of preserved specimens in collections.

The next division of true ducks, according to Mr. Yarrell, includes in the following order the Red-Crested, the Pochard, Ferruginous, Scaup, Tufted, Harlequin, Long-Tailed, and Golden-Eye; and their general distinctions, he remarks, internal as well as external, compared with those of the birds of the first division, will be found of an opposite character. Externally, they exhibit the neck and wings short, the latter only reaching to the origin of the tail-feathers; the tarsi short and compressed; the hind toe lobated, and an extended web to the inner toe. They frequent the sea, or the deep parts of the fresh-water lakes, and have been called Oceanic Ducks; they are seldom seen on land; their walk is embarrassed from the backward position of their legs, but they dive constantly and with great facility, taking their prey at various depths below the surface; their food consists of finned and shell-fish, and marine insects, but of little or no vegetable production; and their powers of flight are moderate. With regard to their soft parts, Mr. Yarrell states that the œsophagus is capable of great dilatation, that the stomach is a muscular gizzard, but that the internal cavity increases in size; the stomachs of the Long-Tailed Duck and Golden-Eye most resembling the stomach of the Mergansers, whilst the intestines and cæcal appendages are shorter, the latter diminishing from 6 inches in the first to 4½ inches in the Tufted Duck, 3 inches in the Long-Tailed, and but 2 inches in the Golden-Eye. The ribs of the birds of this division, according to the same author, are elongated; the keel of the breast-bone gradually decreases in depth; the position of the wings is more forward, and the legs are placed farther back. The tracheæ of these ducks, moreover, are particularly distinguished from those of the others by the enlargement at the bottom of the tube being covered with a delicate membrane, supported by slender portions of bone; the trachea of the Red-Crested Duck is an example of this form, and Mr. Yarrell is of opinion that it may be considered the type of this division.

"As the Egyptian Goose," continues Mr. Yarrell, "has in this arrangement been considered the link between the geese and the first division of the true ducks, from its possessing, with the characters of the former, the bony enlargement of the trachea common to the latter; and the Velvet-Duck, for similar reasons, supplying the link between the two divisions of true ducks, possessing, among other characters, an altered form of the bony enlargement of the trachea of the one, with the lobated toe of the other; so the Golden-Eye, the last of the series, appears to complete the arrangement, by exhibiting some of the characters found in the Mergansers, which are next in succession."

The first point of similarity is found by Mr. Yarrell in the elongated feathers of the top of the head, forming a crest; they agree also, he adds, in the shape of the sternum, and a particular extension of its posterior edge, becoming an ensiform process; and this extension of the edge of the breast-bone prevails in the genera *Colymbus*, *Alca*, and *Uria*: and, with the elongation of the ribs observable in all good salt-water divers, seems intended as a protection to the important viscera of the abdomen, and enables them to resist pressure when below the surface. The Golden-Eye, in the opinion of the same author, is also intermediate in its stomach, intestines, and cæcal appendages, the latter being only 2 inches in length. In the Goosander indeed Mr. Yarrell found that these appendages reached 3 inches; but, as he well observes, the size of the bird being considered, they are reduced on a comparative estimate to less than 2 inches; in the Red-Breasted Merganser he found them to measure but 1 inch, and the Swan he states is without any. In the form of its trachea, the Golden-Eye, it seems, more closely resembles the Mergansers than that of any other duck, by the enlargement in the tube, and in the shape of the labyrinth. "Thus the whole of the numerous species of the *Anatidæ* appear to descend to the more perfect water-birds by gradations, but with well-marked divisions throughout."

Prince C. L. Bonaparte, in his 'Tabella Analitica dei Generi,' ('Specchio Comparativo,' 1827) makes his Ordine *Anseres* consist of five families: the *Longipennes*, the *Lamellosodentati*, the *Steganopodes*, the *Lobipedes*, and the *Pygopodes*. His Famiglia *Lamellosodentati* comprises the two genera *Anas* and *Mergus*, the first of which he characterises thus—"Becco depresso, ottuso, con denti lamelliformi;" and it comprehends the swans, geese, and ducks in the large meaning of the term.

M. Lesson, in his 'Manual' (1828), makes the *Anatidæ* (*Lamellirostres* of Cuvier) the fifth and last family of the sixth order, Les Palmipèdes, *Natatores* of Illiger and Vieillot. Under the *Anatidæ* he arranges the genera *Cygnus*, Meyer; *Anser*, Brisson, with its subgenera; *Cereopsis*, Latham; *Anas*, Linnæus; and *Mergus*, Linnæus. The genus *Anas* he divides into two sections.

Mr. Swainson, in his paper 'On those Birds which exhibit the Typical Perfection of the Family of Anatidæ' ('Journal of the Royal Institution of Great Britain'), remarks, that the most superficial observer, on looking to the family of the *Anatidæ*, or Ducks, under which he will include the geese and swans, must be struck by the remarkable shape and structure of the bill, totally different from that of all other birds. This, in fact, he adds, is the only group in the aquatic order wherein the bill is very considerably dilated in its breadth, and of a texture unusually soft. In addition to these, a third and a very important character is discerned; the cutting margins of the bill are provided with numerous transverse lamellar plaits, so much developed in some species as to project beyond the bill, thus assuming an analogy to the teeth of quadrupeds. This analogy however is more imaginary than real, since these appendages are destined for a very different purpose. The feet, although in general short, are adapted to more than one purpose, since they are not only used for swimming and diving, but for walking.

Mr. Swainson proceeds to state that "the gulls feed indiscriminately upon marine animals, whether living or dead: they are the purifiers of the waters, as the vultures are of the land. The pelicans and the penguins derive their support from those large fish which the more feeble gulls can neither capture nor swallow, while the terns skim the ocean in search of small fish which rise to the surface. But the inconceivable multitudes of minute animals which swarm, as voyagers assert, in the northern seas, and the equally numerous profusion inhabiting the sides of rivers and fresh waters, would be without any effectual check upon their increase, but for a family of birds destined more particularly for that purpose. In the structure accordingly of the ducks we see all these qualifications in the utmost perfection. By means of their broad bill, as they feed upon very small and soft substances, they capture at one effort considerable numbers. Strength of substance in this member is unnecessary: the bill is therefore comparatively weak, but great breadth is obviously essential to the nature of their food. As these small insects also which constitute the chief food of the *Anatidæ* live principally beneath the surface of the mud, it is clear that the bill should be so formed that the bird should have the power of separating its nourishment from that which would be detrimental to the stomach. The use of the laminæ thus becomes apparent: the offensive matter is ejected between their interstices, which however are not sufficiently wide to admit the passage of the insect food at the same time. The mouthful of stuff brought from the bottom is, as it were, sifted most effectually by this curiously-shaped bill; the refuse is expelled, but the food is retained. It is probable also that the tongue is materially employed on this process; for unlike that of all other birds, it is remarkably large, thick, and fleshy. From being so highly developed, it must be endowed with an unusual degree of sensation; and indeed, a very exquisite sense of taste must belong to any animal which has to separate its food from extraneous substances, without deriving any assistance in the process from its powers of sight; against this deficiency nature has wisely provided, by heightening and increasing the senses of taste and touch."

In the physiological series of the Museum of the Royal College of Surgeons in London—Gallery (317)—is the head of a Muscovy Duck, *Anas Moschata*, Linn., showing the serrated character of the margins of the mandibles, and the peculiar tuberosity at the base of the beak; and a good opportunity of studying the structure of the tongue is afforded by the preparations numbered 1468 and 1469. In the former are seen the bones of the tongue and upper larynx of a swan (*Cygnus olor*, Brisson). The glosso-hyal part is broader and longer than it is in the land-birds, corresponding to the greater development of the tongue in the lamellirostral swimming birds, but is devoid of the cartilaginous processes to its posterior angles in the gallinaceous tribe. In the larynx may be distinguished the thyroid, cricoid, and arytenoid cartilages, which in most birds are more or less bony: the thyroid cartilage is the largest, and covers the whole anterior part of the larynx like a shield: the posterior broad part of the cricoid (which is not in this class developed in the form of a ring) supports as usual the arytenoid cartilages which form the rima glottidis; they have muscles for opening and closing that fissure, and the larynx is defended by the latter action alone from the entrance of food or fluid. No. 1469 exhibits the lower jaw, with the tongue and larynx of the same bird, and it will be seen that the tongue is so far developed as to correspond with the form of the lower jaw. It is a thick and fleshy organ, beset with four longitudinal rows of horny tooth-like processes, two at the sides, and two on the dorsum, separated by a mesial furrow: the base of the tongue is also armed with retroverted spines arranged in a chevron figure; similar spines again occur behind the larynx. The apo-hyal and cerato-hyal bones are dissected on one side, but covered by the muscles on the other.

Mr. Swainson, in the paper above quoted, divides the genus *Anas* (which he thus characterises—"bill longer than the head, depressed nearly its whole length; the base not enlarged, the tip very obtuse; the laminæ of the upper mandible generally projecting; hinder toe not dilated, short; claws short, thick") into the following sub-genera:—

1. Typical Group.	Sub-Genera.
Bill spatulate, simple; laminæ considerably projecting	*Anas*, Linn.
2. Sub-Typical Group.	
Bill spatulate, furnished with a lobed membrane; laminæ considerably projecting . .	*Malacorhynchus*, Sw.
3. Aberrant Group.	
Bill of equal breadth; projecting laminæ short, slender, acute, crowded	*Chauliodus*, Sw.
Bill more cylindrical, lengthened; tail long .	*Dafila*, Leach.
Bill depressed, of equal breadth; laminæ distant, obtuse, and generally concealed; tail short	*Boschas*, Antiq.

The type of the genus *Anas* is considered by Mr. Swainson to be the Shoveler Duck; and he thus speaks of the arrangement above set forth:—"In regard to the tabular disposition of the five sub-genera, or types of form, it will be expected that I should say a few words, since it is at variance with the mode of exhibiting circular affinities adopted by that distinguished writer who first detected this arrangement. On this point I must refer the reader to the ornithological volume of the 'Northern Zoology,' now about to appear, where he will find our peculiar views explained and illustrated. I have, indeed, chosen to enumerate, in both instances, the subordinate divisions of the aberrant group, but they are always viewed by me as forming a distinct circle of their own, the primary divisions of every natural group being considered as three and not five. In the present instance, the three sub-genera of *Chauliodus*, *Dafila*, and *Boschas*, possess one common character, in not having the bill conspicuously dilated at its extremity; while their circular succession can hardly be questioned, when we find the greatest modern reformers * leave the Gadwall and the Mallard in the same group; these writers having overlooked the modifications of the laminæ, and passed over the difference in the habits of these birds, as not bearing upon the question. The theory that the mallard is the typical representation of this family has now, I trust, been thoroughly investigated, and demonstrated to be erroneous; † nor can I consider the two circular arrangements ‡ that have been made of the whole family, each apparently perfect, but essentially different, in any other light. They appear to me to be the result of abstract theory, and of a theory misapplied. On the other hand, I deem it but justice to the great merits of another ornithologist of our own country to acknowledge the assistance I have derived from his highly valuable paper on the trachæa (tracheæ) of birds, and, at the same time, to declare that if there is any truth in his own inferences, drawn from internal structure, or in mine, resulting from attention to external form and habits, he has himself marked out the true circle of the *Anatidæ*, so far as the British species are concerned, totally unconscious of having done so. There is, and there cannot be, but one plan of creation. In our efforts to develop this plan we must, as Mr. Yarrell justly observes, 'combine ascertained habits, external characters, and anatomical structure;' and in proportion as we can do this so may we assume that our arrangement is 'natural.'"

Sir John Richardson ('Fauna Boreali-Americana') observes that the *Anatidæ* are "of great importance in the Fur Countries, as they furnish at certain seasons in the year, in many extensive districts, almost the only article of food that can be procured. The arrival of the water-fowl marks the commencement of spring, and diffuses as much joy among the wandering hunters of the arctic regions as the harvest or vintage excites in more genial climes. The period of their migration southward again, in large flocks at the close of summer, is another season of plenty, bountifully granted to the natives, and fitting them for encountering the rigour and privations of a northern winter. The *Anatidæ* have therefore very naturally been observed more attentively than any other family of birds, both by the Indians and white residents of the Fur Countries; and as they form the bulk of the specimens that have been transmitted to England, they are also better known to ornithologists."

* Dr. Leach, Dr. Fleming, Stevens (Stephens ?), Vigors.

† For the demonstration, see the paper quoted.

‡ Linn. 'Trans.' xiv. p. 499; 'Zool. Jour.' iii. (ii.) p. 401.

We shall now proceed to speak of the genera and species of this family under the sub-families—*Phœnicoptinæ*, the Flamingoes; *Anserinæ*, the Geese; *Anatinæ*, the True Ducks; *Fuligulinæ*, the Sea-Ducks; and *Merganinæ*, the Mergansers. The Swans are described in the article CYGNINÆ.

The *Phœnicoptinæ* include a single genus, *Phœnicopterus*, Flamingo of the English, Flammant of the French, *Phœnicopterus* of the ancients and moderns. The position of these birds has been a matter of considerable doubt. The form approaches in some points to *Recurvirostra* [AVOSET] and *Platalea* (the Spoonbills), and in others comes nearest to the *Anserinæ* (Geese). C. L. Bonaparte places it in a family, *Hygrobatæ*, with *Recurvirostra* and *Platalea*, between his family *Pinnatipedes* (Phalaropes, &c.) on the one side and the *Anserinæ* on the other. Mr. Vigors, in his paper 'On the Natural Affinities that connect the Orders and Families of Birds,' thus marks its position among the *Grallatores*:—"Intermediate between *Ardea* and *Ciconia* appear those forms which display so remarkable a dilatation of the bill, the *Cancroma* [BOAT-BILL] *Phœnicopterus*, and *Platalea* of Linnæus. The two last of these groups are equally distinguished by a greater development of the membrane that connects the toes than is observable in the other Waders which join them on each side; and in one of them, the *Phœnicopterus*, this character is carried so far to the extreme as to have occasioned some systematists to place the birds of this genus among the *Natatores* (Swimmers). But the whole of the family have a membrane, more or less extensive, at the base of the toes; and if we compare the feet of the common *Ciconia alba* (Stork), of the *Platalea*, and the *Phœnicopterus*, together, we shall see a gradual increase of this membrane in extent, until it reaches the extreme in the latter genus." Mr. Swainson places the Flamingo among the Swimmers. In his 'Natural History and Classification of Birds' (1836), he says, "The Flamingo, which has the longest legs in the Natatorial order, is so good a walker that it only swims occasionally."

The genus *Phœnicopterus* has the bill strong, higher than it is large, dentilated, conical towards the point, naked at the base; upper mandible suddenly bent, curved at its point on the lower mandible, which is larger than the upper. Nostrils longitudinal in the middle of the bill, pierced through and through near the dome of the upper arête, covered beneath by a membrane. Feet very long; three toes in front, hind toe very short, articulated high up on the tarsus; anterior toes united to the nails by a lunated membrane (membrane découpée). Nails short, flat. Wings moderate; first and second quills longest.

Temminck, whose generic characters we have given, says that the Flamingoes live on the sea-beach or in marshes formed by salt lakes, where their food consists of testaceous mollusks, marine insects (crustaceans?), and the spawn of fish, which they collect by plunging their long neck into the water and turning the head upside down, so as to employ with greater advantage the bend of their bill. They join in large troops and live in societies. Their nest is made in the marshes, and consists of earth piled up, and upon this nest the birds sit astride, because their length of limb hinders them from incubating otherwise. Whether they are reposing or fishing, sentinels are appointed which keep a sort of guard. If anything alarms the védette he utters a trumpeting kind of cry, and the whole flock follow him into the air. They rarely take their repose in any other than open places; and it is asserted that their sense of smelling is so acute that they scent from afar the hunter and fire-arms. Their moult appears to be simple and ordinary, but the young birds differ much from their parents. The red or rosy plumage which covers the adult shows itself gradually, after many moults and a period of about four years. The females are less than the males, and the colours of the former want the purity which distinguish the latter. The young, at their departure from the nest, are white. The body of the Flamingo has hardly a greater covering of down than that of the other Waders, the Avosets alone excepted; and accordingly they do not swim habitually, like the latter birds, when they wish to go from one bank to another in deep water. The palmated feet of the Flamingoes appear to be given them to enable them to sustain themselves on the slimy bottoms of rivers and creeks into which they wade as far as their long legs will allow them, and to walk thereon. As they fly in flocks they make an angle like the Geese. In walking they often apply their upper mandible to the ground, and lean on it as a point of support.

M. Temminck positively asserts that the Flamingo of Europe and that spread over the warm climates of America are different. He states that he knows the plumage of the American Flamingo from its youth to its adult state, and declares that they are all different from the various states of the Flamingo of the ancient continent. The orange-red which pervades the whole of the plumage of the American species when it has arrived at its complete state of development is sufficient to distinguish that bird from our European Flamingo, which is of a rose-colour with wings of purple-red. The young of the latter (*Phœnicopterus Antiquorum*) has the plumage whitish, covered with brown streaks (mèches), very distinctly marked and long, principally on the greater wing-coverts; the American Flamingo (*Phœnicopterus ruber*) is covered in its youth with a dull whitish-gray plumage. Three species are given by M. Temminck:—

1. *P. Antiquorum*, the Flamingo of the ancients; Flammant Phœnicoptère of Buffon; the Flammant and Flamingo of old authors. Locality, south of Europe, Africa, and part of Asia.

2. *P. ruber*, the American Flamingo; Red Flamingo of Wilson! Locality, South America and part of North America.

3. *P. minor*, Flammant Pygmée, previously described by Vieillot as *P. parvus*. Locality, South Africa.

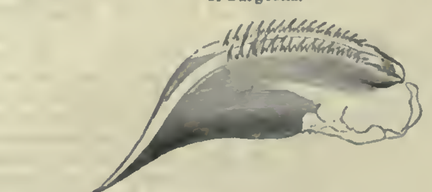
M. Lesson observes that at all events it would be more convenient to retain the original name of Linnæus, *Phœnicopterus ruber*, for the Flamingo of the old continent, and to allow that given by Molina to the American bird, namely, *Phœnicopterus Chilensis*, to remain; although Wilson, who does not appear to have recognised any specific difference, records the last-mentioned Flamingo under the name of *Phœnicopterus ruber*. The latter is used by most of the English zoologists to designate the Flamingo of the Old World; and we shall, adhering to the law of priority and to prevent confusion, adopt the nomenclature suggested by M. Lesson, wishing at the same time that Molina's name had not been a name of locality.

For a knowledge of the internal structure of the Flamingo we are principally indebted to Professor Owen. From the fact of Cuvier placing the Flamingo amongst the *Grallatores*, Professor Owen supposes that an opportunity of dissecting it had never occurred to Cuvier, and that probably the absence of any allusion to cæca in Perrault's anatomical description ('Mémoires de l'Académie,' t. iii. 3 P., p. 462) may have influenced his silence regarding the internal structure of a bird which he considers as one of the most extraordinary and most isolated of its class. Cuvier, in allusion to the small tooth-like laminæ which are arranged along the margins of the upper mandible, points out the relation which the Flamingo bears in this particular to the *Anatidæ;* and Professor Owen states that a like correspondence is observable in the rest of the alimentary canal. "The horny denticles of the upper mandible," he writes, "and the transverse marginal furrows of the lower mandible form together a sort of filter, and like the plates of whalebone in the *Balænæ* allow the superfluous moisture to drain away, while the small *Mollusca* and other littoral *Animalculæ* are detained and swallowed. The structure of the gullet is in accordance with the size of the substances which serve for nutriment. In the typical *Grallatores*, as *Ardea* and *Ciconia*, which swallow entire fish and other food in large morsels, the œsophagus is remarkable for its great and uniform capacity; but in *Phœnicopterus* it is not more than half an inch in diameter when dilated. At the lower part of the neck it expands into a considerable pouch, which measured in the specimen here described 3 inches in diameter and 4½ inches in length. In Perrault's specimen the diameter was only one and a half inch, and it was probably in a state of contraction, as he describes it as furnished internally with many small longitudinal rugæ. The circular fibres around this part were very distinct. Beyond this pouch the œsophagus again contracts to about 4 lines in diameter, and so continues for 3½ inches, when it terminates in the proventriculus. This glandular cavity was 1 inch 8 lines in length and 5 lines in diameter; the gastric follicles were broad, short, and simple, and were arranged in two long oval groups blending together at the edges. The proventriculus terminates in a small but strong gizzard of a flattened spheroidal form, measuring 1 inch 5 lines in length and the same in breadth; the lateral muscles were each half an inch in thickness. The gizzard was lined with a moderately thick and yellow-coloured cuticle disposed in longitudinal ridges, the extremities of which projecting into the pyloric aperture form a kind of valve, as in the gizzard of the Ostrich. In a Flamingo dissected by Colonel Sykes, in which the duodenum was blocked up by two large tape-worms, the muscles of the gizzard were 1 inch in thickness. The duodenal fold extended towards the left side 4 inches from the pylorus. This intestine was 4 inches in diameter. The pancreas, which occupied its common situation between the two portions of the fold, had a more complete peritoneal covering than usual. The intestinal canal soon diminished in diameter to 3 and then to 2 lines. The small intestines formed an oval mass, and were disposed in 21 elliptical spiral convolutions, 11 descending towards the rectum and 10 returning towards the gizzard in the interspaces of the preceding; a disposition analogous to that of the colon in Ruminants. The villi of the intestines were arranged in longitudinal zigzag lines. There were two cæca, each about 3½ inches in length and 5 inches in diameter. The testes were about the size of grains of wheat, and were situated on the anterior part of the renal capsules. The latter bodies were about the size of hazel-nuts. 'Both these glands were of a bright yellow colour. The fat of this bird is

of a remarkable orange tint. The principal diseased appearances were in the lungs, which were filled with tubercles and vomicæ. I was much struck with finding the inner surface of the latter cavities, and that of most of the smaller ramifications of the bronchial tubes, covered over with a green vegetable mould or *Mucor*. As the individual was examined within twenty-four hours after its death, it seemed reasonable to conclude this *Mucor* had grown there during the lifetime of the animal. Thus it would appear that internal parasites are not exclusively derived from the animal kingdom, but that there are *Entophyta* as well as *Entozoa*.' [ENTOPHYTA.]

"The tongue of the Flamingo is remarkable for its texture, magnitude, and peculiar armature. It is almost cylindrical, but slightly flattened above and obliquely truncate anteriorly, so as to correspond with the form of the inferior mandible. The lower part of the truncated surface is produced in a pointed form, and is supported beneath by a small horny plate. The whole length of the tongue is 3 inches; its circumference 2½ inches. Along the middle of the flattened superior surface there is a moderately deep and wide longitudinal furrow, on either side of which there are from 20 to 25 recurved spines, but of a soft and yielding horny texture, measuring from 1 to 3 lines in length. These spines are arranged in an irregular alternate series, the outer ones being the smallest, and these indeed may be considered a distinct row. At the posterior part of the tongue there are two groups of smaller recumbent spines directed towards the glottis. The substance of the tongue is not muscular, but is chiefly composed of an abundant yielding cellular substance, with fat of an almost oily consistence. It is supported by a long and thin concave cartilage articulated to the body of the os hyoides by a shallow ginglymoid joint allowing of a free motion. Excepting the straight hyoglossi, the muscles all terminate at the base of the tongue. The tendons of the former muscles run along the under part of the lingual cartilage, and expand to be inserted at its extremity, where a few fibres again proceed forwards to the extreme point of the tongue." In the Museum of the Royal College of Surgeons in London is a preparation of the crop, proventriculus, and gizzard of a Flamingo (*P. ruber*, Linn.), and a preparation of the tongue of that bird.

Skull and mandibles of the Flamingo. From a specimen in the Royal College of Surgeons.



Tongue of Flamingo. From a specimen in the Royal College of Surgeons.

There were no *Entozoa* in the specimen dissected by Professor Owen; but he characterises the species found by Colonel Sykes, and above alluded to, as *Tænia lamelligera:* length 7 inches; breadth 5 lines; thickness 1 line. ('Zool. Proc.,' 1832, pp. 141 and 143.)

P. ruber, Linn. (*P. Antiquorum*, Temminck). Its length from the end of the bill to that of the tail is 4 feet 2 or 3 inches, but to the end of the claws sometimes more than 6 feet. Bill 4½ inches long; upper mandible very thin and flat, and somewhat moveable; the under mandible thick, both of them bending downwards from the middle; nostrils linear and placed in a blackish membrane; end of the bill as far as the bend black, thence to the base reddish-yellow, round the base, quite to the eye, covered with a flesh-coloured cere; neck slender and of great length; tongue large, fleshy, filling the cavity of the bill, furnished with twelve or more hooked papillæ on each side, turning backwards; the tip a sharp cartilaginous substance. The bird when in full plumage wholly of a most deep scarlet, except the quills, which are black. From the base of the thigh to the claw 32 inches, of which the feathered part takes up no more than 3 inches; bare part above the knee 13 inches, and thence to the claws 16 inches; colour of the bare parts red; the toes furnished with a web deeply indented. Legs not straight, but slightly bent, the skin rather projecting. (Latham.)

The nest is formed of earth, and in the shape of a hillock, with a cavity at top; eggs two or three, white, of the size of those of a goose, but more elongated.

The flesh of this Flamingo is pretty good meat: the young are thought by some equal to partridge. The inhabitants of Provence however are said to throw away the flesh as fishy, and only to use the feathers as an ornament to other birds at particular entertainments. Not so the Roman epicures. Apicius has left receipts for dressing the whole bird with more than the minute accuracy of a modern cookery book, and the 'Phœnicopterus ingens' appears among the luxuries of the table in Juvenal's eleventh Satire. The brains and tongue figure as one of the favourite dishes of Heliogabalus, and the superior excellence of the latter was dwelt upon by the same Apicius, and noticed by Pliny, where he records the doctrine of that "nepotum omnium altissimus gurges." (Lib. x. c. 48.) Neither has it escaped the pointed pen of Martial—

> "Dat mihi penna rubens nomen; sed lingua gulosis
> Nostra sapit: quid si garrula lingua foret?" Lib. xiii.—lxxl.

The 'garrula lingua' most probably alludes to the tongues and brains of singing birds, which sometimes formed one of the monstrous dishes at the enormously-expensive Roman entertainments. Dampier does not forget the delicious tongue of the Flamingo, observing that a dish of these tongues is worthy of a place at a prince's table. The bird itself seems to have been held in high repute by the ancients, for it appears to have been one of the victims offered to Caligula, who is said to have been sprinkled while sacrificing with the blood of a Phœnicopter the day before he was murdered. (Suet. in 'Caligula,' 22, 57.)

European Flamingo (*Phœnicopterus ruber*).

The European Flamingo is recorded as having been seen everywhere on the African coast and the adjacent islands quite to the Cape of Good Hope. There is a specimen in the South African Museum, London. Le Vaillant found thousands of pelicans and flamingoes on the river Klein-Brak, where the water is brackish owing to the flowing of the tide. It has been occasionally observed on the coasts of Spain, of Italy, and on those of France which lie on the Mediterranean Sea; it has been met with at Marseille and some way up the Rhône. Prince C. L. Bonaparte notes it as very rare and accidental in the neighbourhood of Rome. In some seasons it has been remarked at Aleppo and in the parts adjacent. It has been noticed on the Persian side of the Caspian Sea, and thence along the west coast as far as the Volga, but at uncertain times, and chiefly in considerable flocks, coming from the north coast mostly in October and November. Colonel Sykes records it in his catalogue of birds in the Dukhun (Deccan) as the Rajah-Hans of the Hindoos. It breeds in the Cape de Verd Islands. This species is very shy. Dampier killed fourteen at once by secreting himself and two more; they are not to be approached openly. Kolben speaks of their numbers at the Cape, where by day they resorted to the borders of lakes and rivers, and lodged at night in the long grass on the hills.

M. de la Mormora, in his voyage to Sardinia, gives the following interesting account of this species:—It quits Sardinia about the end of March to return about the middle of August: then it is that from the bastion which forms the promenade of the inhabitants of Cagliari flights of these magnificent birds may be seen to arrive from Africa. Disposed in a triangular band they show at first in the heavens like a line of fire. They advance in the most regular order, but at the sight of the neighbouring lake there is a pause in their progression, and they appear for a moment immoveable in the air; then tracing by a slow and circular movement a reversed conical spiral figure they attain the end of their migration. Brilliant in all the splendour of their plumage, and ranged in a line, these birds offer a new spectacle, and represent a small army ranged in order of battle, the uniformity and symmetry of which leaves nothing to be desired; but the spectator should content himself with observing this peaceful colony from afar. Woe to him if he dare to approach the lake at this deadly season.

A group of nine of these beautiful birds are at present (1854) in the Gardens of the Zoological Society, Regent's Park.

P. parvus, Vieillot (*P. minor*, Flammant Pygmée, Temminck). M. Temminck observes that no difference is perceptible between the Flamingo of the ancient continent and that of the New World in the form of the mandibles; their upper mandible shuts on the lower one, and is so constructed as to offer when the bill is shut a very slight difference in the height of the two mandibles. In *P. parvus* the lower mandible, very deep and strongly arched, is formed to receive within the space which separates its walls the whole of the upper mandible, which it entirely hides, so that the upper edges of the lower mandible raise themselves to the height of the surface of the upper jaw.

Small Flamingo (*Phœnicopterus parvus*).

The plumage of the adult is pure rose-colour without spot or streak; the head, the neck, the back, and all the lower parts, are of this beautiful tint, which is more lively and pure in the living bird than in the preserved skin, for the fugitive brilliancy of this tint becomes tarnished, and passes into whitish from exposure to the light. The great wing-coverts and those of the tail are slightly deeper in colour than the other parts of the plumage. The whole wing is covered with feathers of a brilliant scarlet or purple, surrounded by a wide rosy border; the tail-feathers are black. Base of the bill, cere, and region of the eye, deep purple; middle of the lower mandible orange-red, and the point black. Joint of the knee, toes, and their membranes, of a fine red; the tarsus has a livid tint. Total length nearly 3 feet.

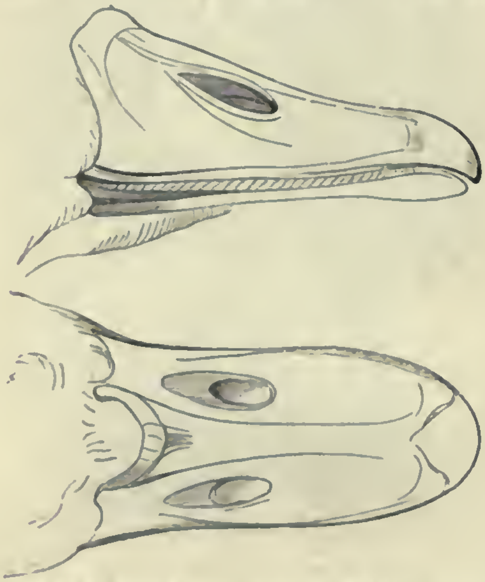
The young of the year are white or whitish, marked with small brown streaks (mèches) spread over the head, the neck, the breast, and the coverts of the wings. The first red tints show themselves on the wings. Bill black. Feet of a reddish livid tint.

This species inhabits the lakes of Africa. Those received by Professor M. Temminck were natives of the Cape of Good Hope. The young bird in the Museum at Paris was brought from Senegal.

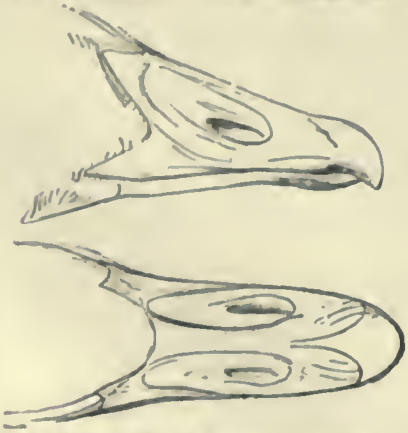
P. Chilensis, Molina (*P. ruber*, Red Flamingo, Wilson). This species in its adult state scarcely differs from the European Flamingo: it is perhaps not so bright. Catesby says, "When they feed (which is always in shallow water, by bending their necks) they lay the upper part of their bill next the ground, their feet being in continual motion up and down in the mud, by which means they raise a small round sort of grain resembling millet, which they receive into their bills; and as there is a necessity for their receiving into their mouths some mud, nature has provided the edges of their bills with a sieve or teeth like a fine comb, with which they retain the food and reject the mud which is taken in with it. This account I had from persons of credit; but I never saw them feeding myself, and therefore cannot absolutely refute the opinion of others, who say they feed on fish, particularly eels, which seem to be the slippery prey Dr. Grew says that the teeth are contrived to hold." The development of the gizzard in this genus makes it very probable that vegetable substances form part of the diet of the Flamingoes; but it is not likely that large fish, or indeed water-animals of any great size, are ordinarily devoured by these birds. The bill is a colander, admirably coutrived for separating the nutritious parts, whether animal or vegetable, from the mud and other useless parts.

The Red Flamingo inhabits the warmer parts of North America, Peru, Chili, Guyana, coast of Brazil, and the West Iudia Islands, particularly the Bahamas, where they breed. Wilson speaks of it, but he gives Latham's description, &c. Prince C. L. Bouaparte, in his 'Specchio Comparativo,' states that it is very rare and accidental in the neighbourhood of Philadelphia.

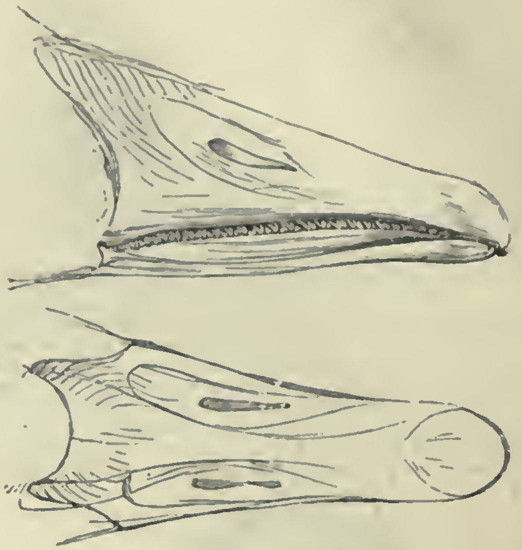
The *Anserinæ* include those birds which are popularly known as Geese. Mr. Swainson, in the 'Classification of Birds,' considers that the *Anserinæ* constitute the rasorial sub-family of the whole group of *Anatidæ*. Although much nearer related, in Mr. Swainson's opiuion, to the True Ducks than are the Flamingoes, next to which he places them, they are, he remarks, nevertheless much more terrestrial in their habits; and in their strong and high legs, fondness for grain and vegetables, and comparative shortness of wing, he traces many of the chief characters of the rasorial type. The first form, after quitting the Flamingoes, seems to him to be the natatorial genus *Cygnus* [CYGNINÆ], which, by its great length of neck and large-sized body, softens down the interval between the Ducks and the *Phœni-*



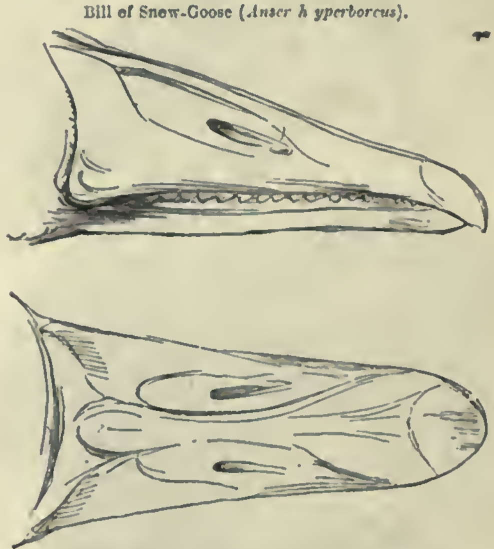
Bill of Egyptian Goose (*Chenalopex Ægyptiacus*).



Bill of Bernicle Goose (*Anser Bernicla*). [BERNICLE GOOSE.]



Bill of Snow-Goose (*Anser hyperboreus*).



Bill of Gray-Lag, or Common Wild Goose (*Anser ferus*).

Bill of Pigeon-Goose (*Cereopsis*), Swainson. [CEREOPSIS.]

coptinæ. "We next," continues Mr. Swainson, "come to the True Geese, forming the genus *Anser*, the typical division of the whole group, and which contains most, if not all, of the usual sub-genera. The Tree Geese (or Ducks, as they have been called) next follow, among which the sub-genus *Chenaloplex* (Chenalopex?) will probably find a place. *Plectropterus* is the rasorial genus analogous, by its spur-wings, to the *Rallidæ*, while the Australian genus *Cereopsis* (equally representing the pigeons) appears alone necessary to complete this circle." In his 'Synopsis' Mr. Swainson makes the *Anatidæ* consists of the following sub-families: — *Phœnicoptinæ*, *Anserinæ*, *Anatinæ*, *Fuligulinæ*, and *Merganidæ* (Merganinæ?).

The cuts in the preceding page will in some degree illustrate the form of the bill in the Geese:—

The genus *Anser* has the following characters:—Beak not longer than the head, conical, elevated at the base, which is covered with a cere or skin; under mandible smaller than the upper; nostrils lateral, placed towards the middle of the beak, pierced anteriorly; legs under the centre of the body; the tarsi long, the hind toe free, articulated upon the tarsus.

A. hyperboreus, Pallas; *A. niveus*, Brisson, the Snow-Goose. It appears to be the *A. hyperborea* of Gmelin; *A. nivalis*, Forster; Snow-Goose of Pennant, Wilson, Bonaparte, and Nuttall; White Brant of Lawson, Lewis, and Clark; Wæwæoo, Wapow-Wæoo (the young Catch-catew-Wæwæoo) of the Cree Indians; Kangokh (plur. Kang-oot) of the Esquimaux; Wavey of the Hudson's Bay residents; L'Oie Hyperborée, ou de Neige, of the French; and Schnee-Gans of the Dutch.

Sir John Richardson gives the following description of a male Snow-Goose killed at Fort Enterprise, lat. 65°, June 1, 1821:—Colour white; quills pitch-black, their shafts white towards the base; head glossed with ferruginous; irides dark hair-brown; bill, feet, and orbits, aurora-red; ungues of both mandibles livid. The ferruginous tint occupies different portions of the head in different individuals, and in some extends to the neck and middle of the belly. An immature bird has a few feathers on the crown and nape, the fore part of the back, ends of the scapulars, some of their coverts, and the outer webs of the tail-feathers, grayish-brown, all tipped and more or less edged with white. Tertiaries and rest of the plumage as in the old bird. Some individuals deviate from the full plumage merely in the bastard wing and primary coverts retaining their gray colour, while in very young birds part of the under plumage is also grayish-brown; bill shaped much like that of *A. albifrons*.

The Snow-Goose feeds principally on rushes, insects, &c., and in the autumn on berries. The rushes, roots of reeds, and other vegetables it tears up, according to Wilson, from the marshes like the hogs, and here its powerful strongly-serrated bill becomes a most useful instrument. Of the berries, the Crow-Berry (*Empetrum nigrum*), appears to be the favourite. Sir John Richardson states that this species breeds in the Barren Grounds of Arctic America in great numbers, and that their eggs are of a yellowish-white colour and regularly ovate form, three inches in length, and two inches in their greatest breadth. At the end of August the young fly, and all have departed southward by the middle of September; but it is said that the young do not attain the full plumage of the old bird before their fourth year, and until then they appear to keep in separate flocks.

In common with most of the True Geese, the plumage of the Snow-Goose is available for adding to the comforts of man, and its flesh, when well fed, is excellent. Richardson states it to be far superior to that of the Canada Goose in juiciness and flavour. At the time of their departure southward from Severn Fort in October, Dr. Latham says that many thousands are killed by the inhabitants, who pluck them, and taking out the entrails, put their bodies into holes dug in the ground, covering them with earth, which, freezing above, keeps them perfectly sweet throughout the severe season, during which the inhabitants occasionally open one of these storehouses, and find the birds untainted and good. In Siberia the same mode of preserving them seems to be practised.

Nuttall states that the Snow-Goose is common to the north of both continents. He says that early in November they arrive in the river Delaware, and probably visit Newfoundland and the coasts of the Eastern States in the interval, being occasionally seen in Massachusetts Bay. They congregate in large flocks, and are very noisy: their note is more shrill than that of the Canada Goose, and they make but a short stay in winter, proceeding farther south as the severity of the weather increases. Prince C. L. Bonaparte notes it as rare and accidental in the winter at Philadelphia. Nuttall further remarks that the Snow-Geese begin to return towards the north by the middle of February, and until the breaking up of the ice in March are frequently seen in flocks on the shores of the Delaware and around the head of the bay. He observes that they are met with commonly on the western side of America, as at Oonalashka and Kamtchatka, as well as in the æstuary of the Oregon, where they were seen by Lewis and Clark. According to Sir John Richardson, they are numerous at Albany Fort, in the southern part of Hudson's Bay, where the old birds are rarely seen; and, on the other hand, the old birds in their migrations visit York Factory in great abundance, but are seldom accompanied by the young. The Snow-Geese, he adds, make their appearance in spring a few days later than the Canada Geese, and pass in large flocks both through the interior and on the coast.

Mr. Gould, who gives a very good figure of the adult in his magnificent work on the 'Birds of Europe,' says that the species inhabits all the regions of the arctic circle, but more especially those portions appertaining to North America. From the northern portions of Russia and Lapland, he adds, where it is sparingly diffused, it regularly migrates to the eastern portions of Europe, and is occasionally found in Prussia and Austria, but never in Holland. To the polar regions, he concludes, it retires as its congenial locality early in the spring, to perform the duties of incubation and rearing its young.

A. ferus, the Gray-Lag Goose. The Domestic Goose is the Oye Privée, and the Wild Goose is the Oye Sauvage of Belon; *Anser ferus* and *Anser* of Gesner and others; *Anser domesticus* and *Anser palustris noster*, Gray Lagg dictus of Ray; *Anas Anser ferus* of Latham; *Anas Anser* of Linnæus. It is the Oca (tame), Oca Salvatica, Oca Grossa col Becco Rosso (wild), and Oca Paglietane, of the Italians; Oie Domestique and Oie Sauvage of the French; Oie Cendrée ou Première of Temminck; Gans, Grau Gans, and Wilde Gemeine Gans, of the Germans; Gaas of the Danes; Gas and Will Gas of the 'Fauna Suecica;' Gwydd of the Welsh, and Goose and Wild Goose of the modern British.

The Gray-Lag, or common Wild Goose, is the origin of the Domestic Goose of our farm-yards. "It is," says Pennant, "the only species that the Britons could take young and familiarise; the other two"—the White-Fronted Goose (*Anser albifrons*) and the Bean-Goose (*Anas segetum*, Lath. and Gmel.) are probably the species meant—"never breed here, and migrate during the summer." The Gray-Lag Goose, then, and the Domestic Goose, may be considered identical. It is the Χὴν of the Greeks and *Anser* of the Romans—the same that saved the capitol by its vigilance, and was cherished accordingly. Pliny (lib. x. c. xxii.) speaks of the bird much at length, stating how they were driven from a distance on foot to Rome; he mentions the value of the feathers of the white ones, and relates that in some places they were plucked twice a year. "Mirum in hac alite, a Morinis usque Romam pedibus venire. Fessi proferuntur ad primos, ita cæteri stipatione naturali propellunt eos. Candidorum alterum vectigal in pluma. Velluntur quibusdam locis bis anno. Rursus plumigeri vestiuntur; molliorque quæ corpori quam proxima, et e Germania laudatissima. Candidi ibi verum minores Ganzæ vocantur. Pretium plumæ eorum in libras denarii quini," &c.

Though this bird is well known, there has been so much confusion, in consequence of there being three species of wild goose, namely, *Anas Anser*, Lin., *A.* (*Anser*) *segetum*, and *A.* (*Anser*) *albifrons*, White-Fronted Wild Goose, that it may be as well to give Pennant's description.

"This," writes Pennant, "is our largest species; the heaviest weigh ten pounds; the length is 2 feet 9 inches; the extent 5 feet. The bill is large and elevated, of a flesh-colour tinged with yellow; the nail white; the head and neck cinereous, mixed with ochraceous yellow; the hind part of the neck very pale, and at the base of a yellowish-brown; the breast and belly whitish, clouded with gray or ash-colour; the back gray; the lesser coverts of the wings almost white, the middle row deep cinereous slightly edged with white; the primaries gray, tipped with black and edged with white; the coverts of the tail and the vent-feathers of a pure white; the middle feathers of the tail dusky, tipped with white, the exterior feathers almost wholly white; the legs of a flesh colour."

In its reclaimed state it varies, like most domesticated animals, infinitely; but it is said always to retain the whiteness of the coverts of the tail and the vent-feathers; the whiter the plumage, the more it is esteemed.

The seas, the shores, and the marshes of the oriental countries are the habitation of the Gray-Lag Goose. It rarely advances northward above 53°; it is abundant in Germany and towards the centre of Europe; in very small numbers, on its passage, in Holland and France. The domestic races, all sprung from this species, multiply in all countries. (Temminck.) "The Gray-Lag is known to inhabit all the extensive marshy districts throughout the temperate portions of Europe generally; its range northward not extending farther than the fifty-third degree of latitude, while southward it extends to the northern portions of Africa, eastwardly to Persia, and, we believe, is generally dispersed over Asia Minor." (Gould, 'Birds of Europe.') Prince Bonaparte notes it as rather common in winter near Rome.

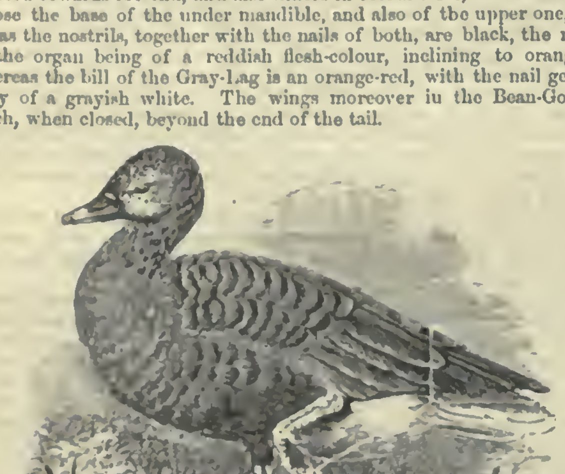
Aquatic vegetables and all sorts of seeds are the food of this bird. "The Gray-Lag," says Gould, "assembles in flocks, and, like the bean-goose, seeks the most open and wild districts, often descending upon fields of newly sprung wheat, which, with the blades of fine grasses, trefoil, and grain, constitute its food." Temminck says that the nest is made in heathy spots (bruyères), and in marshes, upon tussocks of rushes and dried herbs; and that the number of eggs is five, six, or eight, rarely twelve or fourteen, of a dirty greenish-white—Gould says sullied white. Pennant states that this species resides in the fens the whole year, breeds there, and hatches about eight or nine young, which are often taken, easily made tame, and esteemed most excellent meat, superior to the Domestic Goose. The old geese, which are shot, are, he says, plucked, and sold in the market as fine tame ones, and readily bought, the purchaser being deceived by the size, but their flesh is coarse. Towards winter, he adds, they collect in great flocks, but in all seasons live and feed in the fens.

The tame goose is very long lived. "A certain friend of ours"—it is Willughby who relates the story—"of undoubted fidelity, told us that his father had once a goose that was known to be 80 years old, which for ought he knew might have lived the other 80 years, had he not been constrained to kill it for its mischievousness in beating and destroying the younger geese."

It is one of the most useful of birds to man, whether we consider its flesh or its feathers. "Tame geese," writes Pennant, "are kept in vast multitudes in the fens of Lincolnshire; a single person has frequently 1000 old geese, each of which will rear seven, so that towards the end of the season he will become master of 8000. I beg leave to repeat here a part of the history of their economy from my tour in Scotland, in order to complete my account. During the breeding season these birds are lodged in the same houses with the inhabitants, and even in their very bed-chambers; in every apartment are three rows of coarse wicker pens, placed one above another; each bird has its separate lodge divided from the other, which it keeps possession of during the time of sitting. A person called a Gozzard, that is, Goose-Herd, attends the flock, and twice a day drives the whole to water; then brings them back to their habitations, helping those that live in the upper stories to their nests, without ever misplacing a single bird. The geese are plucked five times in the year; the first plucking is at Lady-Day, for feathers and quills, and the same is renewed four times more between that and Michaelmas for feathers only. The old geese submit quietly to the operation, but the young ones are very noisy and unruly. I once saw this performed, and observed that goslins of six weeks old were not spared; for their tails were plucked, as I was told, to habituate them early to what they are to come to. If the season prove cold, numbers of the geese die by this barbarous custom. When the flocks are numerous, about ten pluckers are employed, each with a coarse apron up to his chin. Vast numbers of geese are driven annually to London to supply the markets, among them all the superannuated geese and ganders (called the 'Cagmags'), which, by a long course of plucking, prove uncommonly tough and dry. The feathers are a considerable article of commerce; those from Somersetshire are esteemed the best, and those from Ireland the worst."

The liver seems to have been a favourite morsel with epicures in all ages, and their invention appears to have been active in exercising the means of increasing the volume of that organ. The pâté de foie d'oie de Strasbourg is not more in request now than were the great goose-livers in the time of the Romans. (Pliny, 'Hist.,' lib. x. c. 22, &c.)

A. segetum, the Bean-Goose, one of the wild geese, *Anas segetum*, Gmelin, *Anser ferus*, Ray. It is to be distinguished from the last species by its comparatively small and short bill, which is more compressed towards the end, and also differs in colour: for, in the Bean-Goose the base of the under mandible, and also of the upper one, as far as the nostrils, together with the nails of both, are black, the rest of the organ being of a reddish flesh-colour, inclining to orange; whereas the bill of the Gray-Lag is an orange-red, with the nail generally of a grayish white. The wings moreover in the Bean-Goose reach, when closed, beyond the end of the tail.



The Bean-Goose (*Anser segetum*).

Selby gives the following interesting account of its habits from personal observation:—

"In Britain it is well known as a regular winter visitant, arriving in large bodies from its northern summer haunts, during September or the beginning of October, and seldom taking its final departure before the end of April or beginning of May. The various flocks, during their residence in this country, have each their particular haunts or feeding districts, to which, on each ensuing season, they invariably return, as I have found to be the case in Northumberland and the southern parts of Scotland, where wild geese have been known to frequent certain localities for a continued series of years. The habits of this and the preceding species are very similar, and they show the same vigilance, and use the same means of guarding against surprise: their capture is therefore proportionally difficult, and it is only by stratagem that, when at rest on the ground or feeding, they can be approached within gun-shot. In stormy weather when they are compelled to fly lower than they usually do, they may be sometimes intercepted from a hedge or bank, situated in the route they are observed to take early in the morning, in passing to their feeding ground. At night they retire to the water, or else (as I have often remarked in Northumberland) to some ridge or bar of sand on the sea-coast, sufficiently distant from the mainland to afford a secure retreat; and where the approach of an enemy must become visible, or at least audible to their acute organs, before it could endanger their safety. The haunts or feeding-grounds of these birds are more frequently in the higher districts than in the lower and marshy tracts of the country, and they give the preference to open land, or where the inclosures are very large. They feed much upon the tender wheat, sometimes injuring these fields to a great extent; and they frequent also the stubbles, particularly such as are laid down with clover and other grasses. In the early part of spring they often alight upon the newly-sown bean and pea fields, picking up greedily such of the pulse as is left on the surface; and I am inclined to think that their trivial name has been acquired from their apparent predilection for this kind of food, rather than from the shape and aspect of the nail of the upper mandible, to which it has been generally attributed. They usually fly at a considerable elevation, either in a diagonal line, or in two such lines, opposed to each other, and forming a leading acute angle, like the other species; and when on wing they maintain a loud cackling, in which the voices of the two sexes may be easily distinguished. The rate at which they move, when favoured by a gentle breeze, is seldom less than from 40 to 50 miles an hour, a velocity which enables them to have their roosting-place far removed from the district they frequent by day. The principal breeding stations, or summer retreats, of the bean-goose are in countries within the arctic circle: it is said, however, that great numbers breed annually in Harris, and some of the other outermost Western Islands. The nest is made in the marshy grounds, and formed of grasses and other dry vegetable materials; the eggs are white, and from eight to twelve in number. The trachea of this species increases in diameter towards the middle, and the bronchiæ are short and tumid. The denticulated laminæ of the sides of the bill are similar in formation to those of the *A. palustris*, and form thin sharp cutting edges, and the manner in which they lock within each other renders the bill an instrument beautifully adapted for vegetable food."

In bulk, the Bean-Goose is generally rather less than the Gray-Lag and it is accordingly sometimes called provincially the Small Gray-Goose, but it not unfrequently equals the other in size and weight.

The head and upper part of the neck incline to brown, with a grayish tinge, and the feathers of the latter hue are so disposed as almost to produce a furrowed appearance. The lower parts of the body are ash-gray, with transverse darker shades; and the back and scapulars are brown, with a gray tinge, the feathers being edged with white. Wing-coverts gray; secondaries brown, edged and tipped with white; primaries gray-black; rump gray; upper tail-coverts white; tail brown, with the feathers deeply bordered and tipped with white; legs and toes reddish, inclining to orange, the intensity of the colour varying according to the bird's age.

A. Ægyptiacus, Brisson (*Anas Ægyptiaca*, Linnæus), the Egyptian Goose. It appears to be the Χηναλώπηξ of the Greeks, and accordingly the modern zoologists have named it *Chenalopex Ægyptiacus* (Gould, 'Birds of Europe'). Aristotle ('Hist. Anim.' lib. viii. c. 3) mentions the *Chenalopex* as a palmipede bird haunting the banks of lakes and rivers. Aristophanes names it in two of his comedies, namely, 'Birds,' v. 1295, 'Lysistr.' v. 956. (In the 'Lysistrate' the Ravenna Manuscript reads Χηναλώπηξ: but Bekker prints Χυναλώπηξ, noticing the Ravenna reading.) Athenæus mentions it with praise on account of its eggs, as claiming the second place in excellence, those of the peacock holding the first ('Deipn.' lib. ii. c. 16, p. 58). Ælian (lib. v. c. 30; lib. xi. c. 38) notices it, and speaks of its cunning.

But it is Herodotus who draws our attention to the bird as one of those held sacred by the Egyptians ('Hist.' lib. ii. c. 72), and the researches of modern travellers have fully shown that it was at least a favourite dish with the priests. It is impossible to look at the Egyptian paintings and sculptures—many will be found in the British Museum, and many more copied in Rosellini, and other works of the same kind—without being struck with the frequent occurrence of geese represented, both alive and plucked, and prepared for the table. That some of these represent the *Chenalopex* there can be no doubt. The author of the interesting book on Egyptian Antiquities ('Library of Entertaining Knowledge—Egyptian Antiquities,' vol. ii., London, 1836), gives a print containing, as he believes, all or nearly all the varieties of the animal forms, except perhaps the fishes, which he had been able to find on the great sarcophagus, the two obelisks, and some other monuments in the British Museum. Among them he figures a palmipede bird, which he considers to be the Egyptian Goose, the *Chenalopex* of Herodotus; and he observes that it is of frequent occurrence on the sculptures, though it was not a sacred bird; unless it may have some claims to that honour from having been a favourite article of food for the priests. A place in Upper Egypt, he remarks, had its name Chenoboscion, or Chenoboscia ('goose-pens'), from these animals being fed there, probably for sale; though these may have been sacred geese, for the goose, we are told, was a bird under the care of Isis. Every one recollects, he adds, the story in Livy, of the geese of Juno saving the capitol. The bird referred to, if accurately figured, and we are told that the drawing was executed with great care, seems too short upon its legs for the Egyptian Goose of modern authors, and has more the air of a Bernicle.

Belon gives a fair description of the Egyptian Goose; among other observations he says, "Estant de la forme d'une oye, et le col long, et la corpulence plus petite, semble estre haut enjambée;" and he applies to the bird, which he describes, the name of *Vulpanser*, or *Chenalopex*. He speaks also of its being kept "es cours des grand seigneurs seulement." M. Geoffroy St. Hilaire is also of opinion that the Egyptian Goose is the *Chenalopex*, or *Vulpanser*, of the ancients; and Mr. Stephens conferred the former generic title on the species.

The genus *Chenalopex* has the following characters:—Bill as long as the head, slender, nearly straight, rounded at the tip, laminated on the margin; upper mandible slightly curved, nail hooked, lower mandible flat. Nostrils sub-basal: upper mandible margined all round with brown, reddish flesh-colour in the centre; irides orange. Wings with spurs. Tarsi elongated; the three anterior toes fully webbed; hind toe simple. Legs placed in equilibrio with reference to the body.

The sexes are nearly similar; female rather smaller than the male, and with the colouring less intense. Narrow edging of feathers round the base of the bill, a line running nearly straight from that edging to the eye, and large patch surrounding the eye, chestnut; crown of the head, sides of the face, and anterior part of neck, pale buff approaching to white, gradually passing into rufous-brown on the back of the neck; lower part of the neck of the same reddish tinge, which forms there a slightly marked collar. Upper part of the back light chestnut-brown, rayed with very minute transverse irregular lines of dark brown approaching to black; middle of the back and upper part of scapulars dark reddish-brown, minutely rayed with irregular transverse lines of blackish-brown and gray; lower part of scapulars and tertiaries reddish chestnut; lesser wing-coverts white, except the posterior row of feathers, which are crossed with black near their extremities, so as to form a narrow oblique band across the wing; primaries, lower part of the back, rump, and tail, black; secondaries rich green, glossed with purple. In the middle of the breast there is a large patch of deep chestnut; the rest of the under part of the body, from the slight collar to the thighs, pale buff with fine irregular transverse blackish-brown lines. Vent and under tail-coverts rich buff. Legs and feet reddish flesh-colour.

Egyptian Goose (*Chenalopex Ægyptiacus*).

Mr. Gould, who gives an excellent portrait of an adult male in his 'Birds of Europe,' states that he has not been led to do so by the number of half-reclaimed individuals which are yearly shot in our island, but from the circumstance of its occasionally visiting the southern parts of the Continent from its native country, Africa. M. Temminck, he remarks, particularly mentions the island of Sicily as one of the places frequented by it; and he adds that this is the species which would appear to have been held in great veneration by the ancient Egyptians, as we frequently find a figure of it among the monuments of that celebrated people. It is, he says, abundant on the banks of the Nile, and is distributed over the whole of the vast continent of Africa.

This handsome species breeds freely in confinement, and is often seen in the aviaries and near the lakes of those who take pleasure in collecting and domesticating ornamental water-birds.

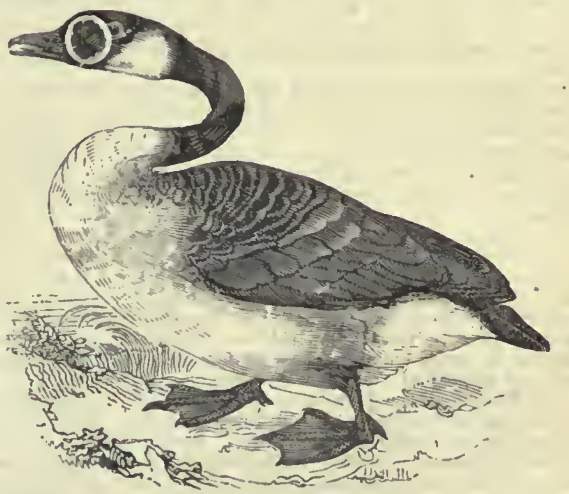
A. Gambensis of Ray and others, *Anas Gambensis* of Linnæus, *Plectropterus Gambensis* of modern ornithologists, the Spur-Winged Goose, or Gambo-Goose. This species was confounded by Willughby, and afterwards by Buffon, with the Egyptian Goose.

Size nearly that of the common goose; but the legs are long, and placed under the middle of the body. Bill broad and flat, with a tubercle at the base like that of the tame swan. This tubercle increases with age. Bend of the wing armed with a large blunt spur, which is sometimes double. Bill and its basal tubercle dull red; sides of the head white; upper parts of body glossy black, with metallic reflections; base of the wings with a white patch mottled with black spots; under parts white; legs slightly tinged with red; spur, which is only visible when the wing is expanded, horn-colour.

Mr. Swainson thus characterises the genus *Plectropterus*, Leach:—"Size large; wings armed with naked tubercles or spines; bill lengthened, wide at the tip; the base with a naked protuberance. Rasorial."

It is a native of Northern and Western Africa. One specimen was killed in Cornwall in 1821, hence it is enumerated in lists of British *Anatidæ*. More rare in collections than the Egyptian Goose, but has lived well in the Gardens of the Zoological Society of London, at the Regent's Park.

A. Canadensis of authors, the Canada Goose, or Cravat-Goose. This bird in its contour, especially about the neck, seems to approach the swans. Indeed, Mr. T. C. Eyton arranges it under the genus *Cygnus*. It is the Neescah, or Mistehayneescah, of the Cree Indians; L'Outarde of the French-Canadians; Bustard of the Hudson's Bay settlers; Wild Goose of the Anglo-Americans; and L'Oie à Cravate of the French.



Canadian Goose (*Anser Canadensis*).

Hearne, Pennant, Wilson, Audubon, Nuttall, and others, give very interesting accounts of the habits and chace of this species, whose annual advent furnishes such an abundant harvest of food to the residents in the countries visited by it. Our limits will not permit us to indulge in these entertaining but somewhat lengthened narratives, and we select Sir John Richardson's account as being at once clear and concise:—"The arrival of this well-known bird," says Sir John in the 'Fauna Boreali-Americana,' "in the Fur Countries is anxiously looked for, and hailed with great joy by the natives of the woody and swampy districts, who depend principally upon it for subsistence during the summer. It makes its first appearance in flocks of twenty or thirty, which are readily decoyed within gun-shot by the hunters, who set up stales, and imitate its call. Two or three, or more, are so frequently killed at a shot, that the usual price of a goose is a single charge of ammunition. One goose, which when fat weighs about nine pounds, is the daily ration for one of the Company's servants during the season, and is reckoned equivalent to two snow-geese, or three ducks, or eight pounds of buffalo and moose-meat, or two pounds of pemmican, or a pint of maize and four ounces of suet. About three weeks after their first appearance the Canada Geese disperse in pairs throughout the country, between the 50th and 67th parallels, to breed, retiring at the same time from the shores of Hudson's Bay. They are seldom or never seen on the coasts of the

Arctic Sea. In July, after the young birds are hatched, the parents moult, and vast numbers are killed in the rivers and small lakes when they are unable to fly. When chased by a canoe, and obliged to dive frequently, they soon become fatigued, and make for the shore with the intention of hiding themselves; but as they are not fleet they fall an easy prey to their pursuers. In the autumn they again assemble in flocks on the shores of Hudson's Bay for three weeks or a month previous to their departure southwards.

"It has been observed that in their migrations the geese annually resort to certain passes and resting-places, some of which are frequented both in the spring and autumn, and others only in the spring. The Canada Goose generally builds its nest on the ground; but some pairs occasionally breed on the banks of the Saskatchewan in trees, depositing their eggs in the deserted nests of ravens or fishing eagles. Its call is imitated by a prolonged nasal pronunciation of the syllable *wook* frequently repeated."

The principal food of this species consists of sedge-roots, herbage, and delicate marine plants, such as those of the genus *Ulva*. In the spring they feed on berries which have been preserved by the snow through the winter, such as those of the Silvery Buckthorn (*Eleagnus argentea*). M. Audubon found them breeding on the coast of Labrador; the eggs, six or seven in number, of a greenish-white, are laid in a roughly-made nest. Mr. Nuttall says that in the month of March, 1810, many were nesting in the Shave-Rush (*Equisetum hyemale*) bottoms of the Missouri, no farther up than Fire Prairie, considerably below the junction of the river Platte; so that the breeding range of the Canada Goose probably extends through not less than 30 degrees of latitude. Prince Bonaparte notes it as common in winter near Philadelphia, and as being an object of chase on the sea-shore in the autumn.

When it is remembered that the Hudson's Bay residents depend greatly on the supply of Canada Geese for their winter provision, and that in favourable years as many as 3000 or 4000 are said to have been killed and barrelled up, it is evident that without this aid numbers must be in a very forlorn condition. It has been asserted that on a good day a single native from the ambush of his bough hut will kill as many as 200. They are preserved in the frost with the feathers on, and the flesh is juicy and nutritious, though not equal to that of the Snow-Goose. The feathers also are of commercial value. The bird has been long domiciled in Europe, in France, and in this country particularly, where it breeds freely, and is a great ornament. Buffon states that it bred with the swans at Versailles; it will breed also with the Common Goose. The produce of the latter intermixture are said to be much more delicious in flavour and quality than the unmixed progeny of the Domestic Goose.

The following is the description of this bird:—Head, two-thirds of the neck, greater quills, rump, and tail, pitch-black. Back and wings broccoli-brown, edged with wood-brown. Base of the neck before and the under plumage generally brownish-gray. A few feathers about the eye, a large kidney-shaped patch on the throat, the sides of the rump, and upper and under tail-coverts, pure white. Bill and feet black.

Sir John Richardson observes that individuals differ considerably in dimensions.

The author last above quoted states, as a summary in the 'Fauna Boreali-Americana,' that the geese feed on vegetable substances, pasturing by day, and retiring in the night to repose on the water. This must be taken as a general proposition, for the Canada Goose is said rarely to sleep upon the water except in very calm weather, their roosting-place being mostly in the marshes. He says that they swim well, but dive only when moulting and unable to fly. If pursued at such times they leave the water, and try to hide themselves on shore. They fly high and swiftly in flocks arranged in two lines meeting in an acute angle: they alight on the ground, seldom on the water. The same author observes that *Anser albifrons* and *A. hyperboreus* feed chiefly on berries, and are seldom seen on the water except in the night or when moulting; that they frequent the sandy shores of rivers and lakes in flocks, one of their number generally doing duty as sentinel, and that both species breed in great numbers in Arctic America and on the islands of the Polar Sea. *A. albifrons* he states to be rare on the coast of Hudson's Bay, and says that it migrates over the interior, and chooses its breeding-places in the vicinity of woody tracts; while *A. hyperboreus* visits both the interior and the coast in its migrations, but resorts to the Barren Grounds to breed. "*A. Canadensis*," writes Sir John Richardson in conclusion, "is abundant in pairs throughout the Fur Countries up to a high latitude. It associates in flocks only on its first arrival. It feeds on grass and on all kinds of berries. Early in the spring I have found its crop filled with the farinaceous astringent fruit of the *Eleagnus argentea*. *A. Bernicla* and *A. Hutchinsii* breed in considerable numbers on the shores and islands of the Arctic Sea, but keep near the sea-coast in their migrations, and are seldom seen in the interior. They feed on marine plants and on the *Mollusca* which adhere to them, as well as on grass and berries. Prince C. L. Bonaparte enumerates *A. segetum* and *A. leucopsis* in his list of American Geese; but they did not come under our notice in the Fur Countries. Hutchins and Hearne speak of the Canada Goose under the name of Common Gray Goose, what they term Canada Goose being our *A. Hutchinsii*."

This sort of practical information is not merely interesting in a philosophical point of view. The observations which Sir John Richardson's opportunities enabled him to make become of great practical importance when it is considered that upon the habits and migratory movements of this useful tribe depend the comfort, nay, almost the existence, of multitudes of human beings. We shall therefore follow these birds through Sir John Richardson's 'Table;' and we would earnestly entreat all zoological travellers to keep such registers whenever their position will enable them to add such valuable contributions to natural history. The Table from which the following extract is made embraces the whole of the birds comprised in the 'Fauna Boreali-Americana.' Sir John Richardson remarks that the fourth column is taken from Prince Bonaparte's 'Specchio Comparativo,' and that the fifth column is filled up on the authority of that naturalist, Wilson, Audubon, and some others.

Species.	Extreme Northern range. Distribution in the Fur Countries. Whether resident or migratory.	Species observed on the Saskatchewan; lat. 53° to 54° N., and from 600 to 1000 miles distant from the sea-coast.	Species that frequent the vicinity of Philadelphia, lat. 40° N. (Bonaparte.)	Winter Quarters of the Species.
Anser albifrons	73° N. Lat. East of Rocky Mountains. Migratory.	Passage. Spring and Autumn. In flocks. Very abundant.	Winter. Accidental visiter.	Middle and Southern States.
Anser hyperboreus	73° N. Lat. Across the Continent. Migratory.	Passage. Spring and Autumn. In flocks. Very abundant.	Winter. Accidental visiter.	United States.
Anser Canadensis	70° N. Lat. Across the Continent. Migratory.	Summer. Common.	Winter. Common.	Middle States.
Anser Bernicla	73° N. Lat. East of Rocky Mountains. Migratory.	Passage. Spring and Autumn. Accidental.	Winter. Common.	Southern States.
Anser Hutchinsii	60° N. Lat. East of Rocky Mountains. Migratory.	Passage. Spring and Autumn. In flocks.		

With regard to the further geographical distribution of this tribe the reader will find *A. Indicus*, Barred-Headed Goose, Lath.; *A. melanotos*, Black-Backed Goose, Lath.; and *A. Coromandeliana*, *Anas Girra*, Gray and Hardw.; *Girra Teal*, Lath., in the catalogue of birds which were collected on the Ganges between Calcutta and Benares, and in the Vindhyian Hills between that place and Gurra Mundela, on the Nerbudda, by Major James Franklin, F.R.S., &c. ('Zool. Proc.,' 1830-31.) *Anser Girra* (*Anas Girra*, Gray), called the Cotton-Teal by the Europeans in the Deccan, on account of the quantity of white in the plumage, appears also in the account of Colonel Sykes's collection of birds from the Deccan. ('Zool. Proc.,' 1832.) *Anser inornatus* is recorded among the birds brought home from the Straits of Magalhaens by Captain Philip Parker King, R.N. ('Zool. Proc.,' 1830-31.) Mr. Gould, in his 'Century of Birds from the Himalaya Mountains,' figures *A. Indicus* as occurring there.

The sub-family *Anatinæ*, the True Ducks, have a very wide geographical distribution. Sir John Richardson, in the work last quoted, states that *Anas clypeata* and *A.* (*Dafila*) *acuta* frequent chiefly the clear lakes of the northern districts, and breed in the Barren Grounds, being found in numbers in the more southern woody districts in spring and autumn only. *A.* (*Boschas*) *domestica*, *A.* (*Chauliodus*) *strepera*, and *Mareca Americana* breed in the woody districts up to their most northern limits, in latitude 68°. *A.* (*Boschas*) *crecca* is abundant to the extremity of the continent both in the woody and barren districts. *A.* (*Boschas*) *discors*, though very plentiful on the Saskatchewan, was not observed farther north than the 58th parallel; while *Dendronessa sponsa* seldom goes to the northward of the 54th degree of latitude, and is rare even to the southward of that parallel.

It appears also from Sir John Richardson's 'Tables' that *Anas clypeata* was observed in 70° N. lat. migratory across the continent; numerous: that it was observed on the Saskatchewan, in 53° to 54° N. lat., and from 600 to 1000 miles distant from the sea-coast, very common as a bird of passage in spring and autumn; that it frequents the vicinity of Philadelphia, rather common in winter (Bonaparte); and that its winter quarters are in the United States and Mexico. *A.* (*Chauliodus*) *strepera* has been noticed in 68° N. lat. east of the Rocky Mountains, migratory; and on the Saskatchewan (same range of latitude and same distance from the sea-coast) common in summer; rare in the vicinity of Philadelphia in winter (Bonaparte): its winter quarters are the Mexican lakes. (Swainson.) *A.* (*Dafila*) *caudacuta*, in lat. 70° east of the Rocky Mountains; migratory; very common; and on the Saskatchewan, as above, in spring and autumn, but not rare; common in the vicinity of Philadelphia in winter (Bonaparte); and having its winter quarters in the Mexican lakes. (Swainson.) *A.* (*Boschas*) *domestica*, in lat. 68°; migratory across the continent: common on the Saskatchewan, as above, in the summer; common in the vicinity of Philadelphia in the winter (Bonaparte); and having its winter quarters in the Middle and Southern States, Columbia River and California. *A.* (*Boschas*) *crecca*, in lat. 70°; migratory across the continent; very abundant; on the Saskatchewan, as above, abundant in summer; very common near Philadelphia in the winter (Bonaparte): and with its winter quarters in the Middle and Southern States towards the tropics. *A.* (*Boschas*) *discors*, in lat. 58°; migratory across the continent; very abundant; and on the Saskatchewan, as above, abundant in summer; very common near Philadelphia in summer (Bonaparte); and with the Mexican States, Columbia River, and California for its winter quarters. *Mareca Americana*, in lat. 68°; migratory; rather common on the Saskatchewan, as above, in summer; common near Philadelphia in the winter (Bonaparte); wintering in the Middle and Southern States and in the West Indies. *Dendronessa sponsa*, in lat. 54°; migratory; rare on the Saskatchewan, as above, in summer; common in the vicinity of Philadelphia in summer (Bonaparte); wintering in the Southern States, Mexico (?) West Indies.

In the same work we find in the list of species which merely winter in Pennsylvania, and migrate in summer to rear their young in the Fur Countries, *A. clypeata*, *A.* (*chauliodus*) *strepera*, *A.* (*Dafila*) *caudacuta*, *A.* (*Boschas*) *domestica*, *A.* (*Boschas*) *crecca*, and *Mareca Americana*;—in the list of species which summer (or breed) in the Fur Countries and in Pennsylvania, but winter farther to the southward, *A.* (*Boschas*) *discors* and *Dendronessa sponsa*;—and in the list of species common to the Old World and the Fur Countries, *A. clypeata*, *A.* (*Chauliodus*) *strepera*, *A.* (*Dafila*) *acuta*, *A.* (*Boschas*) *domestica*, and *A.* (*Boschas*) *crecca*.

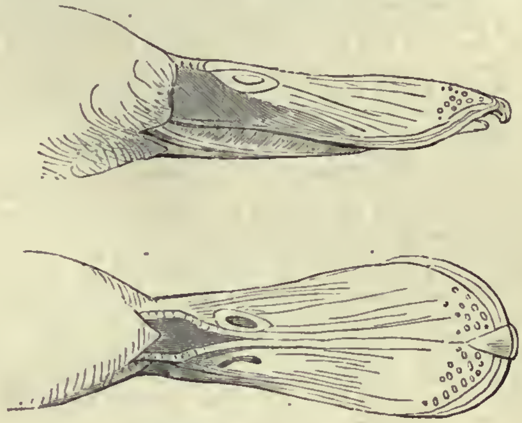
The *Anatinæ* feed on soft substances, such as fresh-water insects and tender aquatic plants, which they procure near the surface, or, aided by the length of their necks, at the bottom, in shallow muddy places, and worms and slugs, which they search for among the grass. By day they resort to small lakes and rivers, and in the night retire to the fields. They are strong and swift on the wing, and are watchful birds, that seldom dive to escape pursuit, unless when moulting; but when disturbed fly away, making at the outset a circle in the air to survey the cause of their alarm. ('Fauna Boreali-Americana.') Sir John Richardson gives in a note the following interesting information, derived from an intelligent keeper of a decoy in the neighbourhood of the Rev. W. Booth of Friskney, in Lincolnshire, to whom he expresses his obligation for the statement:—"Skelton is unacquainted with the habits of the gadwall; but he tells me that the widgeon and pintail do not willingly dive: of course, if driven to it, they can, but they do not dive for their food; and though in play they sometimes splash under water, they never remain beneath the surface like the pochard. With respect to food, the mallard, pintail, and teal, frequent rich flooded lands, 'swittering with their nebs in the soil, and sucking out its strength;' but the widgeon feeds quite differently, being 'an amazing fowl to grazo, a strange eater of grass.' It is especially fond of 'flutter-grass' (*Glyceria aquatica vel fluitans ?*), which it crops on the surface, but it likewise eats many other herbs. When the decoy has been so full of widgeons that they have devoured every blade on the landings, Skelton has taken advantage of their absence in the night, when they resort to the green salt marshes on the sea-coast, and laid down sods pared from the fields, on which they readily graze. In common, however, with the mallard, teal, and pintail, they are fond of willow-weed-seeds (*Epilobium ?*), with which he feeds all the fowl in the decoy, as they prefer it to oats and every other kind of grain. Mr. Waterton states that 'the widgeon feeds by day, eating grass like a goose; whilst its congener the mallard invariably refuses this food, and seeks for its susteuance by night.'"

The genus *Anas* has the following characters:—Bill about as long as the head, broad, depressed, sides parallel, sometimes partially dilated; both mandibles furnished on the inner edges with transverse lamellæ; nostrils small, oval, lateral, anterior to the base of the beak; legs rather short, placed under the centre of the body; tarsus somewhat rounded; toes three in front, connected by intervening membranes; hind toe free, without peudant lobe or membrane; wings rather long, pointed. Tail pointed or wedge-shaped. The sexes differ in plumage.

Anas clypeata (Linn.), the Shoveler. This is the Souchet of the French; Cucchiarone of the Italians; Schild-Ente and Löffel-Ente of the Germans; Mimenick of the Cree Indians; Hwyad Lydaubig of the Welsh; *Rhynchaspis clypeata* of Shaw's Zoology (Leach MSS.); *Spathulea clypeata* of Fleming. The *A. rubens* of Gmelin is said to be the young male, or a variety of the young male. It is provincially termed Blue-Winged Shoveler, Kertlutock, and Broad-Bill.

The following is the description of a male killed at Fort Franklin, May, 1826:—Colour: head, adjoining half of the neck, medial stripe to the interscapulars, the whole back, interior scapulars, and primaries, umber-brown; sides of the head, the neck, and crest, glossed with duck-green; rump and tail-coverts above and below, with blackish green. Lower half of the neck, the breast, shoulders, shorter scapulars, ends of the greater coverts, and sides of the rump, white; longer scapulars striped with berlin-blue, white, and blackish-brown. Lesser coverts berlin blue. Speculum brilliant grass-green, broadly bordered above, and narrowly edged below with white; bounded interiorly with greenish-black. Belly and flanks deep orange-brown, the latter undulated posteriorly with black. Bill black. Legs orange.

The bill is a little higher than wide at the base, much depressed, dilated, and rounded at the end; mandibles furnished with long slender crowded laminæ, the upper ones acute and projecting, forming an apparatus admirably fitted for sifting small insects from the water



Bill of Shoveler (*Anas clypeata*).

surface of the upper mandible pitted near its oblong unguis. Wings scarcely an inch longer than the tail, which is graduated, moderately acute, and consists of 14 acute feathers; tarsus scarcely compressed; hind toe not lobed, and the outer-toe shorter than the middle one, as in the rest of the *Anatinæ*.

The female is liver-brown above, with broad boarders of pale wood-brown; underneath pale wood-brown with obscure liver-brown marks. She wants the dark brown and green colours of the head, rump, and tail-coverts, the white of the neck, breast, sides of the rump, and scapulars, and also the orange-brown of the belly; the lesser coverts are slightly glossed with berlin-blue, and the speculum is less vivid than in the male. Length 21 inches 6 lines, &c. (Richardson.) The weight is about 22 ounces.

Temminck states that the young males in autumn, and the old males during their moult, have some of the feathers proper to the winter-plumage of the male, and others peculiar to the female, or to the young male before the moult, and that these feathers are indistinctly mingled. Young and old males in the summer-change are supposed to be the origin of the Red-Breasted Shoveler.

Shoveler (*Anas clypeata*).

The trachea of the male is of equal diameter, excepting towards the lower larynx, where it is very slightly enlarged. It forms a slight bony protuberance on the left side, which is dilated a little below. The bronchiæ are very long. (Temminck.)

It inhabits marshes, lakes, and rivers in Russia, and a great part of Asia. It is very abundant in Holland. In France, Germany, and England, it is a bird of passage, arriving in the British Islands generally about October, and departing about March. In England the principal resorts of the species are the fens of Lincolnshire and Cambridge. Bonaparte ('Specchio Comparativo') notes it as one of those birds common to the neighbourhoods of Rome and of Philadelphia, and as being rather common in both places in winter.

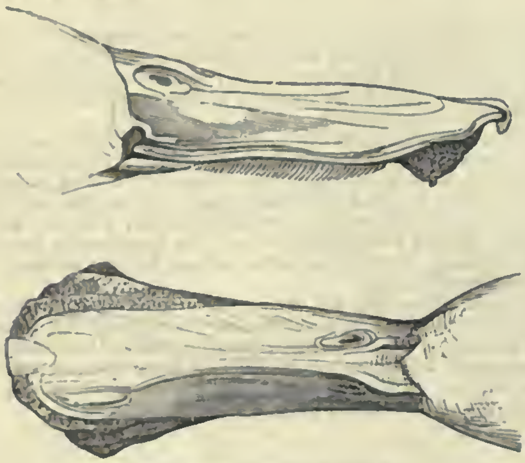
According to Latham it inhabits the Coromandel Coast and parts of India. The form occurs in Australia (New Holland Shoveler); and Swainson says that the geographical distribution of the true Shovelers may be deemed universal.

It lives on fishes and insects, rarely plants and seeds. (Temminck.)

It makes its nest upon the borders of lakes covered with reeds or coppice, and lays 12 to 14 eggs of a bright greenish-yellow, or oil-green. It is said to have bred in France, and has been known to breed in the marshes of Norfolk, and in the neighbourhood of the Tweed. But these may be deemed exceptions to the general place of nidification, which is far north.

The flesh is highly esteemed for the table, and is considered by many to excel that of the mallard, or common wild-duck, in flavour.

Malacorhynchus (Swainson).—Mr. Swainson ('Journal of the Royal Institution,' loc. cit.) observes that among the broad-billed ducks of the southern hemisphere there is a very remarkable modification of form. The breadth of the bill and the length of the laminæ are nearly the same; but the edge of the upper mandible, instead of being smooth, as in the European species, is furnished with a thin membranaceous skin, which projects considerably, and hangs down somewhat like a wattle on each side. Mr. Swainson proposes for this form the sub-generic name above given, remarking that the bill of the European Shoveler is flexible, but that in this group it is much more so. One species, he adds, described by authors under the name of the Soft-Billed Shoveler, can scarcely exhibit this debility more than another before him when he wrote his paper: it came, according to him, from the same country (Australia?), and seems to be undescribed.



Bill of *Malacorhynchus*, Swainson.

Chauliodus (Swainson).—Mr. Swainson states that the Gadwall certainly makes as near an approach to the Shovelers as any other yet known. "The form of the bill, indeed, is no longer spatulate, or perceptibly broader towards the end; but the laminæ of the upper mandible are still very fine, distinct, and more numerous than those of any other form subsequently mentioned, for they project a full tenth of an inch beyond the margin. The tail now begins to be lengthened, and in a new species from Africa (*C. Capensis*), which I have recently received, is so much attenuated, as to evince an evident affinity to the Pintail-Duck forming the sub-genus *Dafila* of Dr. Leach."

Bill of Gadwall (*Chauliodus*), Swainson.

C. strepera (Swainson), the Gadwall, or Gray.—This is the Chipeau, or Ridenne of the French; Anitra Montanara and Anatra Canapiglia of the Italians; Schwatter-Ente and Grave Mittel-Ente of the Germans; and Y gors llwyd lwyd of the Welsh.

The following is the description of a male killed on the Saskatchewan, May 22, 1827:—Top of the head and nape liver-brown, edged with gray; head beneath and neck gray, with small brown specks; base of the neck above and below, anterior part of the back, exterior scapulars, flanks, and sides of the vent, clove-brown, marked with concentric horse-shoe-shaped white lines; interior scapulars, lesser coverts, primaries, tertiaries, and tail, hair-brown; intermediate coverts chestnut-brown; greater coverts, rump, and upper and under tail-coverts, bluish-black; speculum white, its anterior border black; lower part of the breast, middle of the belly, and under surface of the wings, white; bill brownish-black, pale beneath; legs orange-coloured.

The bill as long as the head, of equal breadth and height at the rictus; depressed, but not widening anteriorly; laminæ of the mandibles rather stronger and much shorter than those of the Shoveler, but finer and more numerous than those of any northern species. The upper ones project a full tenth of an inch beyond the margin. Wings nearly equal to the tail; first and second quills equal and largest; tail consisting of 16 feathers, the lateral ones graduated; total length 23 inches, &c. (Richardson). Size rather less than that of the widgeon. Temminck makes the length 18 or 19 inches. The female has the feathers of the back of a blackish-brown, bordered by bright ruddy (roux); the breast reddish-brown, marked with black spots; no zigzags on the flanks; rump and lower coverts of the tail grayish. The trachea of the male is slightly enlarged in its diameter at about two-thirds of its length, but becomes narrower as it approaches the lower larynx: this consists of a large bony arch, with a globular or rather pyriform bladder attached to the left side, being in shape much like that of the common mallard, but smaller.

Gadwall (*Chauliodus strepera*).

This bird inhabits the marshes, &c. of the north and east of Europe, and is very abundant in Holland. It is rarely seen in the British Islands except at the period of its vernal migration, and then generally in the marshes of Norfolk. It is common in winter on the maritime coasts of France; rare in the interior. Bonaparte ('Specchio Comparativo') notes it as rather common in the neighbourhood of Rome in the winter.

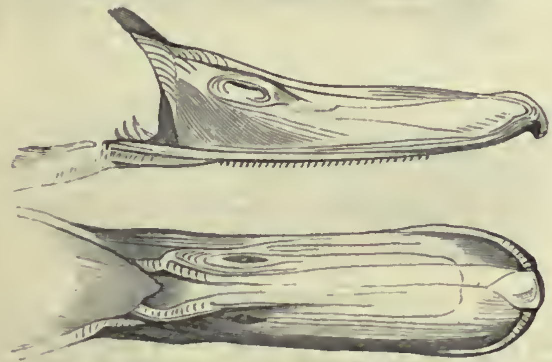
It feeds on fishes, mollusks (coquillages), insects, and aquatic plants. (Temminck.) Insects and their larvæ, aquatic plants, and seeds. (Selby.)

It makes its nest in the most covered part of marshes, or rushy meads, and lays 8 or 9 eggs of a greenish-ash, according to Temminck; 10 to 12 eggs of a pale oil-green. (Selby.)

Mr. Swainson observes that nature has now so far receded from the typical form that one of the chief peculiarities of that structure is nearly lost, and another considerably modified. The laminæ of the upper mandible, which in *C. strepera* are so much shorter than those of the true Shovelers, and are so much abbreviated in *C. Capensis*, become almost concealed by the margin of the bill in *Dafila*. "The most striking characteristic therefore of the genus we are now considering," continues Mr. Swainson, "has nearly disappeared, precisely in that form which is farthest removed from the type. But the shape of the bill, although essentially modified, has not undergone a total alteration; its breadth towards the tip is not only as great as at the base, but is even more dilated; so that in this respect it resembles the Shovelers more than the Gadwalls, while it differs from both in being higher at its base, considerably more lengthened in proportion, and much more convex throughout. It assumes, in short, a semi-cylindrical form, the end being particularly obtuse and slightly dilated; the precise point of junction between the Pintails and that group which was known to the ancients by the name of *Boschas*."

Dafila caudacuta, tbe Pintail-Duck. This is Le Canard à Long Queue ou Pilet of the French; Anitra Codilanza and Anatra di Coda Lunga of the Italians; Spiess-Ente and Fasan-Eute of the Germans; Aler, Ahlvogel, of the 'Fauna Suecica;' Sea-Pheasant, or Cracker, of Willughby; Keeneego Yaway-Sheep of the Chippeway Indians; Hwyad Gynffonfain of the Welsh; *Anas caudacuta* of Ray; *A. longicauda* of Brisson; *A. acuta* of Linnæus; *Querquedula acuta* of Selby.

The following is the description of a male killed on tbe Saskatchewan, May, 1827:—Head and adjoining part of the neck anteriorly umber-brown, witb paler edges; neck above blackish-brown; the whole of the back, shorter scapulars, sides of the breast and flanks, marked with fine waved transverse lines of brownisb white and black, most regular and broadest on the long feathers lying over the thighs; long scapulars and tertiaries black, the borders of the former and outer webs of the latter white; wing-coverts and primaries hair-brown; the primary shafts white, and the interior coverts mottled with the same; speculum dark-green, with purple reflections, bounded above by a ferruginous bar, and interiorly and below by wbite. Tail and most of its upper coverts dark-brown with pale borders. Two long ceutral npper coverts, vent, and under coverts, black; the latter bordered with wbite. A lateral streak on tbe upper part of the neck, the sides and frout of its lower part, the breast, and belly, white. The posterior part of the abdomen minutely marked with gray. Bill black; sides of the upper mandible bluish-gray. Feet blackish-gray.



Bill of Pintail-Duck (*Dafila caudacuta*), Swainson.

The bill is much lengthened, fully as long as the head, considerably higher tban wide at the base; tbe upper mandible of equal breadtb to the point; tbo laminæ not projecting beyond the margin. Wings two inches shorter than tbe tail. Scapulars, tertiaries, tail-feathers and their coverts, tapering and acute; the middle pair of tail-coverts having long slender points that project two inches and a half beyond tbe tail. Tail graduated. Tracbeal dilatation a small osseous sac, the size of a hazel-nut. Total length, 26 incbes 6 lines. (Richardson.) Selby observes that tho labyrinth of this species consists of a round long bladder situated on the left side of the arch of the lower larynx; its upper surface being ucarly even with the top of the arch, but its lower one reaching much below it. Its texture very fine, and in young birds may be indented by slight pressure, but becomes brittle in adults. The weigbt of the bird is about 24 ounces.

Pintail-Duck (*Dafila caudacuta*).

The femalo is smaller. Forehead and crown palc cbestnut-brown streaked with black. Cheeks and neck pale ochreous yellow, speckled with black. Chin and throat palc cream-yellow. Sides of the breast hair-brown, barred and tipped with wbite. Mantle and scapulars amber-brown, barred and varied with pale buff-orange and white. Tertials hair-brown, margined witb wbite. Lesser and greater wing-coverts pale broccoli-brown, edged and tipped with white. Speculum hair-brown glossed witb green, the feathers having white tips. Quills hair-brown. Tail deep hair-brown, witb imperfect bars of white and pale buff-orange; the two middle feathers exceeding tbe rest in length about half an inch. Belly and abdomen yellowish-white, indistinctly marbled witb broccoli-brown. Under tail-coverts white, speckled with chestnut-brown of different shades. Bill grayisb-black. Legs and toes gray, tinged with brown. (Selby.)

The young males bave the head red-brown spotted with black; belly yellowish; and tbe speculum of a green, inclining to olive, witbout reflections.

Selby remarks that, like many otber of tbe *Anatidæ* (particularly of the species belonging to this group), the plumage of the male Pintail, towards the end of summer, or after the sexual intercourse is completed, undergoes a remarkable change, and becomes very like that of the female. This appears to be an actual change of the colour in the feathers ratber than a renewal of them; and the same change, he adds, is observable in tbe Mallard, and the males of the Teal, Widgeon, &c. It also prevails, if not in all, at least in some species of the genus *Mergus*, as be noticed it in *M. serrator*.

It is found in the north of Europe and America; very numerous at its double passage in Holland and in France; equally abundant in Germany; in winter in the soutb. (Temmiuck.) Selby says, "It is with us a regular winter visitant, and considerable numbers are annually taken in tbe decoys of Lincolnshire, Norfolk, &c. Montagu says that it is most abundant in the north of England and Scotland, and especially in the Orkney Islands. This assertion however I must in part contradict, as the result of long observation tells me it is of rare occurrence in the northern counties of England; and the same may be said of the southern districts of Scotland, which Dr. Fleming confirms in his history of British animals. With respect to tbe Orkneys I cannot speak so confidently, although it appears probable tbat what bad becn represented to bim as tbe present species was in fact the Long-Tailed Duck (*Harelda glacialis*), whicb is found in great numbers during the winter in the bays of this group of islands. The Pintail has a wide geograpbical range, being met with in all the northern parts of Europe, Asia, and America, and retires in the summer to breed in high latitudes. Its equatorial migration extends as far as Italy; and during its periodical flight to the soutbward it occurs abundantly in Holland, France, Germany, and other contiuental states. Tbe marshes of the interior part of the country, and fresh-water lakes, are its usual places of resort." Pennant states tbat Mr. Hartlib, in the Appendix to his 'Legacy,' tells us tbat these birds are found in great abundance in Connaught in Ireland, in the month of February only, and that tbey are much esteemed for their delicacy. Prince C. L. Bonaparte ('Specchio Comparativo') notes it as not very rare in the winter near Rome.

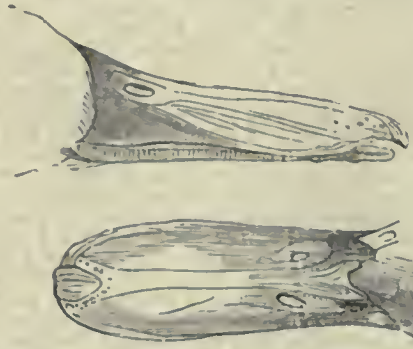
Its food is similar to that of tbe Gadwall. (Temminck.) Selby says tbat its food consists of insects and tbeir larvæ, the seeds of aquatic plants, particularly of some species of *Epilobium*, and vegetables.

The season of courtship is indicated in tbe male by suddenly raising bimself upright in tbe water, bringing his bill close to his breast, and uttering at tho same time a low soft note. This gesticulation is often followed by a jerk of the hinder part of the body, which is tben also thrown above the water. The nest is built in rushes aud the thick herbage of marshes. Eggs, from 8 to 10, bluish-white (Selby); 8 or 9, greenish-blue. (Temminck.)

Selby observes that the Pintail is easily domesticated, but rarely breeds in confinement. A hybrid progeny has been produced between it and tbe Widgeon; and to such an extent do the sexual propensities seem to be affected in this state by difference of food and other causes, that Montagu mentions a male Pintail in his menagerie which for want of the other sex showed an inclination to pair witb a female Scaup, and even with a Bernicle Goose. He further adds, that one of them did pair with a tame duck, but that none of the eggs (upwards of 20 in number) proved to be fccundated.

Boschas.—Mr. Swainsou comprehends under this sub-genus all tbose ducks usually denominated Teals, together with the Mallard, long domesticated in our poultry-yards. "As this," continues Mr. Swainson, "is by far the most uumerous group, so it exhibits a greater diversity of form among the species. They are all however characterised by a bill longer than the head, whose breadth is equal throughout; it is sometimes indeed a littlo dilated, but never contracted at its tip, wbile the laminæ of thc upper mandible are entirely concealed by the margin of tbe bill. The ueck and thc tail, which in *Dafila* are both considerably lengthened, are much shorter in this group, which is further distinguished by the brightness and beauty of plumage observed in nearly all the species. On comparing the bill of the common Teal with that of the Pintail, we see a close affinity between the two forms. But as the tail of the first is so much developed in comparison to tbat of the Teal, it becomes essential to discover, if these sub-genera actually followed each other in nature, what species united them more closely. By the uniform liberality of the zoologists attacbed to the British Museum, and more particularly Dr. J. E. Gray, I am now enabled to do tbis. The beautiful *Anas* (*Boschas*) *formosa*

Sw., or Baikal Teal of methodists, is precisely a bird which intervenes between these two sub-genera. Essentially a Teal, it differs from all others I have yet seen in the superior length of its tail, the feathers of which are a full inch longer than the under-covers; while the convexity of the bill, from being greater than in the common Teal, establishes its close approximation to *Dafila*. Proceeding thus by analysis, we find several foreign species which may be either called Teal or Ducks. The *Boschas Javensis*, Sw., is more especially a bird of this description. It is closer allied to the Mallard than to any other of the group: this is indicated by the more depressed form of the bill, and the white collar round the neck; the nape also is very conspicuously crested, a peculiarity found in no other group of the genus. To this and to the curled tail of the tame duck we shall presently advert. Having now reached what appears to be the typical form of *Boschas*, we see that nature as usual again departs from it. The bill of the Mallard is throughout more depressed than that of the common Teal. This depression in fact, from being greater than that of the Gadwall, or of the Pintail, obviously assimilates more to the Shoveler. The affinity however appears remote, since the laminæ of the Mallard are concealed, while those of the Shovelers are conspicuously projecting. If therefore the affinity was immediate, it could only be demonstrated by a species having the bill of the common duck, but with the laminæ projecting. Now such a species is actually the Blue-Winged Teal of North America, in which these



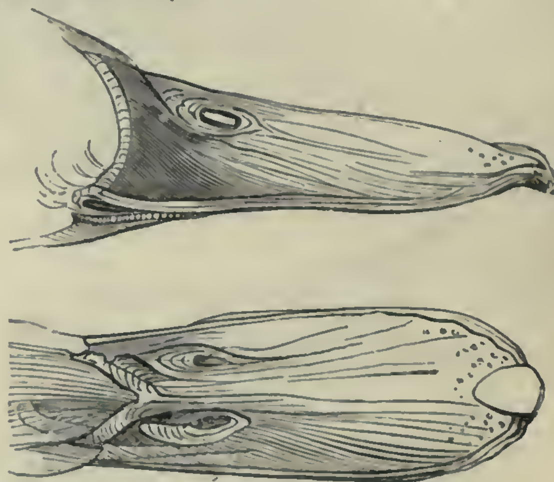
Bill of Blue-Winged Teal (*Boschas discors*).

laminæ project nearly as much as in the Gadwall, while the upper mandible exhibits that peculiar sinuosity towards the base which is seen in no other ducks besides the Shovelers. If this affinity required any further support, it is placed beyond doubt by the fact mentioned in the 'General History of Birds,' that the plumage of the New Holland Shoveler, excepting the white facial crescent, is precisely the same as that of the Blue-Winged Teal,—the very bird which thus unites the sub-genus *Boschas* to that of *Anas*, and completes the circle of the whole group."

Blue-Winged Teal (*Boschas discors*).

B. domestica, the Common Mallard, or Wild Duck. Both sexes of this beautiful bird are so well known that either description or figure would be superfluous. It is the Canard Sauvage of the French; Capo Verde (the male), Anitra (the female), Germano, and Paperone, of the Italians; Wilde Ente and Gemeine Ente of the Germans; Ethinneesen Sheesheep of the Cree Indians; Stock-Duck of the Hudson's Bay residents; and Cors Hwyad, Garan Hwyad, and Hydnwy, of the Welsh.

The weight of the wild Mallard is usually about two pounds and a half. The abundance of the bird at one time in Britain may be judged of from the following passage in Pennant:—"Amazing numbers of ducks, widgeons, and teals are taken: by an account sent us of the number caught, a few winters past, in one season, and in only ten decoys, in the neighbourhood of Wainfleet, it appeared to amount to 31,200, in which are included several other species of ducks; it is also to be observed that, in the above particular, widgeon and teal are reckoned but as one, and consequently sell but at half the price of ducks. . . . The account of the numbers here mentioned relates only to those that were sent to the capital. It was customary formerly to have in the fens an annual driving of the young ducks before they took wing. Numbers of people assembled, who beat a vast tract, and forced the birds into a net placed at the spot where the sport was to terminate. A hundred and fifty dozens have been taken at once; but this practice being supposed to be detrimental, has been abolished by act of parliament." Selby observes upon this, that the same district at the present time does not produce perhaps a dozen broods in the year.



Bill of Mallard (*Boschas domestica*), Swainson.

Mr. Waterton has pointed out that the duck and the drake are clothed in the same plumage only for a very short time in the summer. Mr. Selby's observations on the change of plumage are referred to under the account of the Pintail.

The trachea of the Mallard has at its lower extremity a labyrinth much larger than that of the Gadwall, but not unlike it; the tube does not differ much in diameter throughout its length.

The Wild Duck is widely spread over a considerable portion of the globe. Few of the temperate and arctic regions are without it. Temminck places its habitation in the northern countries, and observes that it is known as a bird of passage nearly throughout Europe, haunting rivers, lakes, and marshes. Prince C. L. Bonaparte ('Specchio Comparativo') mentions it as very common near Rome in winter.

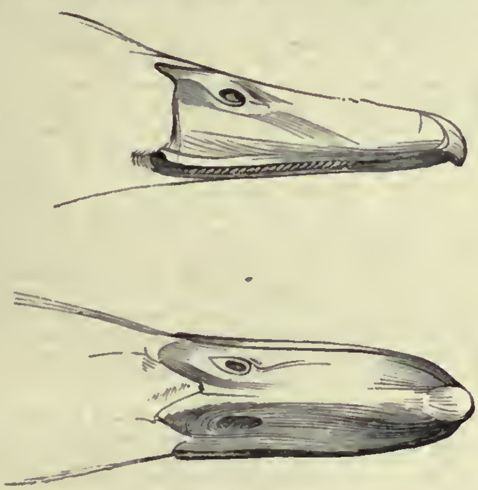
The Wild Duck feeds on fishes, fry or spawn, slugs, water-insects, aquatic plants, their seeds, and all sorts of grain (Temminck)—insects, worms, slugs, and all kinds of grain, &c. (Selby.)

"In a natural state," says Selby, "wild ducks always pair, though in a state of domestication they are observed to be polygamous. The pairing takes place towards the end of February or beginning of March, and they continue associated till the female begins to sit, when the male deserts her, joining others of his own sex similarly situated; so that it is usual to see the mallards, after May, in small flocks by themselves. About this time also they begin to undergo the changes of colour that assimilate them in a great degree to the female, and which is retained till the period of the autumnal or general moult. The care of the young thus devolves entirely upon the duck, and is not partaken by the male, as Wilson and others appear to think; and this fact I have had frequent opportunities of verifying, as many wild ducks annually breed upon the edges of our Northumbrian moors, and the young broods are of course frequently under inspection as they descend the rivulets to the lower marshy parts of the country. The nest of the wild duck is generally made in some dry spot of the marshes, and not far from water, to which she can lead her progeny as soon as hatched. It is composed of withered grass and other dry vegetable matter, and usually concealed from view by a thick bush or some very rank herbage, though other and very dissimilar situations are occasionally chosen, as several instances have been recorded where they have deposited their eggs on the fork of a large tree, or in some deserted nest. Such an instance once occurred within my knowledge, and near my own residence, where a wild duck laid her eggs in the old nest of a crow, at least thirty feet from the ground. At this elevation she hatched her young; and as none of them were found dead beneath the tree, it is presumed she carried them safely to the ground in her bill, a mode of conveyance known to be frequently adopted by the Eider-Duck." Montagu ('Ornith. Dict.' Suppl.) says, "We have been assured by a person of undoubted veracity that a half-domesticated duck made a nest in Rumford Tower, hatched her young, and brought them down in safety to a piece of water at a considerable distance. Others have been known to breed in trees; and we recollect the nest of this bird being found in the head of an old pollard willow, impending the water, from whence the young might readily drop unhurt into their natural element. Mr. Tunstall mentions one, at Etchingham, in Sussex, which was found sitting upon nine eggs, on an oak-tree, twenty-five feet from the ground: and the author of the 'Rural Sports' records an instance of one taking possession of the nest of a hawk in a large oak. To these we can add, upon the testimony of a gentleman of the strictest veracity, that out of a large flock of half-domesticated ducks, one deposited her eggs in the principal fork of a large tree near his house." The eggs are 10 to 14, of a bluish-white; the female, when she quits the nest for food, covers them with down and other substances.

In a domesticated state it is most widely distributed. All the varieties that the fancy of the breeder can produce are to be seen in the various poultry-yards. To say nothing of the Aylesbury and other breeds, where size and delicacy of flesh have been principally considered, we find penguin ducks standing nearly erect, hooked-bill ducks, and even a variety where the caprice of man has succeeded in nearly obliterating the webs of the feet, and curtailing the bill till it has lost its spatulate shape and is become a deformity, bearing some resemblance to the bill of a common fowl. Some of these birds have been shown as the offspring of a cock and a duck, we need hardly say, without the slightest foundation for the monstrous assertion. Selby observes, that in the domesticated varieties the peculiar specific distinction of the curled feathers of the tail is still retained. In China and the other countries of the East, numbers of ducks are hatched by artificial means.

Latham states that the male Muscovy Duck and common duck will breed together. The young bear a greater resemblance to the common duck than to the Muscovy Duck.

Mareca, Stephens.—In 'Fauna Boreali-Americana,' Mr. Swainson places the genera *Mareca* and *Dendronessa* in his sub-family *Anatinæ*.



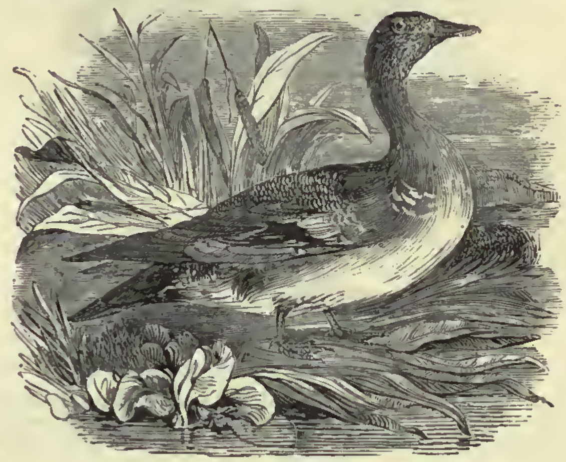
Bill of Widgeon (*Mareca*).

Selby says that the Widgeons are distinguished from the Teals by a much shorter and less cylindrical bill; and from the Ducks, by that member becoming more contracted and narrow, instead of widening towards its tip. The laminæ of the bill are also broader and set wider apart, approaching in form nearer to those of the sub-family *Anserina*. These birds, he adds, also vary in their habits, for instead of searching and sifting the mud with their bills for insects, seeds, &c., upon which food most of the other genera live, they subsist principally on grasses and vegetable diet, which they pluck in the same manner as geese. Their flight is strong and swift, and they have a peculiar shrill whistling call-note. In the shape of the tracheal labyrinth they resemble the Pintail more than any other species: the middle feathers of the tail are also acute, and considerably longer than the rest.

M. Americana (Stephens), American Widgeon. This is the *Anas Americana* of Gmelin and of Sabine, in Frankland's 'Journal,' and Atheekemow-weeshep of the Cree Indians.

The following is a description of a male killed on the Saskatchewan, May, 1827:— A white band from the forehead to the nape, bounded behind the eye by a broad dark-green patch, which ends in the nuchal crest. Upper part and sides of the breast brownish-red, glossed with gray. Base of the neck above, interscapulars, scapulars, and flanks, minutely undulated with brownish-red and black; hind part of the back undulated in a similar manner with clove-brown and white, the latter colour prevailing on the tail-coverts. Lesser wing-coverts, primaries, and tail, clove-brown; intermediate and greater coverts, sides of the rump, breast, and belly, pure white. Speculum velvet-black below, duck-green above, bounded superiorly with black and posteriorly with white. Exterior webs of the tertiaries, and lateral and inferior tail-coverts, greenish-black, the first bordered with white. Bill bluish-gray, bordered and tipped with black.

The bill is particularly short, being not so long as the head, armed with laminæ resembling those of the mallard. Plumage of the nape somewhat lengthened. Wings, above an inch shorter than the acutely-pointed tail, which consists of 14 feathers. Total length, 23 inches. The female has the upper plumage dark liver-brown, edged and remotely barred with pale-brown and white. The intermediate wing-coverts are merely edged with white, and there is no green on the head. Tail, shorter and not so tapering. Total length about two inches less than the male. (Richardson.)



American Widgeon (*Mareca Americana*).

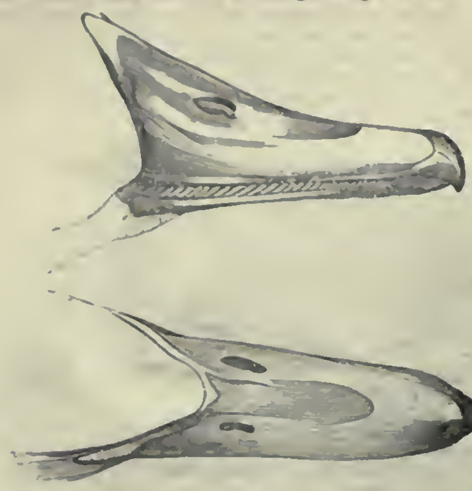
Wilson says this bird is very common in winter along the whole coast from Florida to Rhode Island; but most abundant in Carolina, where it frequents the rice plantations. In Martinico great flocks take short flights from one rice-field to another during the rainy season, and are much complained of by the planters. They are said to be in great plenty in St. Domingo and Guyana, where they are called Vingeon or Gingeon. Are said sometimes to perch on trees. Feed in company (but little in the day), and have a sentinel on the watch. Come out from their hiding-places in the evening. Are not known to breed in any part of the United States. Are common in the winter months along the bays of Egg Harbour and Cape May, and also those of the Delaware. They leave their places in April, and appear upon the coast of Hudson's Bay in May, as soon as the thaws come on, chiefly in pairs; lay there only from six to eight eggs, and feed on flies and worms in the swamps; depart in flocks in autumn. (Wilson here quotes Hutchins.) Wilson further states, that the Widgeon is extremely fond of the tender roots of that particular species of aquatic plant on which the Canvass-Back Duck, so abundant in Chesapeak Bay, feeds. The Widgeon is its constant companion; and the Widgeon, which never dives, watches the moment of the Canvass-Back's rising with the morsel for which the latter bird has dived, and before he has his eyes well opened, snatches it and makes off. On this account the Canvass-Backs and Widgeons, or, as they are called round the bay, Bald Pates, live in a state of perpetual contention.

Dendronessa (Swainson).—Head crested. Bill as high at the base as it is broad; towards the tip narrow and contracted. Nostrils placed towards the middle of the bill. Tertial feathers ornamented. Feet as in *Anas*. Type, *Dendronessa galericulata*, Chinese Teal. Edwards, pl. 102.

Mr. Swainson, who thus characterises the genus, observes ('Fauna Boreali-Americana') that "this is obviously the Rasorial type of the *Anatinæ*. The *D. sponsa*, by the lateral advancement of the bill towards the eye, is a more aberrant species, and shows the connection of the group to *Somateria*."

D. sponsa (Swainson), the Summer-Duck. This is the Wood-Duck of Audubon, Ansee-awmo of the Chippeways, *Anas sponsa* of Linnæus.

The following is a description of a male killed at Cumberland House, lat. 54°; June, 1827. Head above and space between the eye and bill glossy dark-green; cheeks and a large patch on the sides of the throat purple, with blue reflections; pendent occipital crest of green and auricula purple, marked with two narrow white lines, one of them terminating behind the eye, the other extending over the eye to the bill; sides of the neck purplish-red, changing on the front of the neck and sides of the breast to brown, and there spotted with white. Scapulars, wings, and tail, exhibiting a play of duck-green, purple, blue, and velvet-black colours; interscapulars, posterior part of the back, rump, and upper tail-coverts, blackish green and purple; several of the lateral coverts reddish-orange; a hair-like, splendent, reddish-purple tuft on each side of the rump; the under coverts brown. Chin, throat, a collar round the neck, a crescentic bar on the ears, the middle of the breast, and whole of the abdomen, white. Flanks yellowish-gray, finely undulated with black; the tips of the long feathers, and also those on the shoulder, broadly barred with white and black. Inner wing-coverts white, barred with brown. Almost all the coloured plumage shows a play of colours with metallic lustre. Bill red; a space between the nostrils, its tip, margins, and lower mandible, black. Legs orange-coloured.



Bill of Summer-Duck (*Dendronessa sponsa*), Swainson.

The bill shorter than the head; considerably narrowed towards the tip, like that of the Eider; its height at the rictus greater than its width; its frontal angles prolonged. Mandibles strongly toothed. Unguis strong, arched or hooked. Nostrils large, pervious, lateral. Forehead sloping. Occipital crest long and pendent. Wings shorter than the tail, which consists of 16 wide rounded feathers. Total length 21 inches. The female wants the fine lines on the flanks and the hair-like tufts on the sides of the rump. She has a shorter crest; and the plumage is less vivid, especially about the head, where it is mostly brown. (Richardson.)

Summer-Duck (*Dendronessa sponsa*), male.

Audubon states that this species ranges over the whole extent of the United States, and that he saw it in all parts, from Louisiana to the confines of Maine, and from the vicinity of the Atlantic coasts as far inland as his travels extended. It also occurs sparingly during the breeding season in Nova Scotia; but farther north he did not observe it. Everywhere in this immense tract he found it an almost constant resident; for some spend the winter even in Massachusetts, and far up the warm spring waters of brooks on the Missouri. It confines itself however entirely to fresh-water, preferring at all times the secluded retreats of the ponds, bayous, or creeks, that occur so profusely in the woods. Well acquainted with man, they carefully avoid him, unless during the breeding season, when, if a convenient spot is found by them, they will even locate themselves about the miller's dam.

Catesby says that the Summer-Ducks breed in Virginia and Carolina, and make their nests in the holes of tall trees (made by woodpeckers) growing in water, particularly cypress trees. "While they are young and unable to fly, the old ones carry them on their backs from their nests into the water; and at the approach of danger, they fix with their bills on the backs of the old ones, which fly away with them." Audubon's evidence, which we here give, differs from that of Catesby in some particulars. "The Wood-Duck breeds in the Middle States about the beginning of April, in Massachusetts a month later, and in Nova Scotia or on our northern lakes seldom before the first days of June. In Louisiana and Kentucky, where I have had better opportunities of studying their habits in this respect, they generally pair about the 1st of March, sometimes a fortnight earlier. I never knew one of these birds to form a nest on the ground or on the branches of a tree. They appear at all times to prefer the hollow broken portion of some large branch, the hole of our largest woodpecker (*Picus principalis*), or the deserted retreat of the fox squirrel; and I have been frequently surprised to see them go in and out of a hole of any one of these, when their bodies while on wing seemed to be nearly half as large again as the aperture within which they had deposited their eggs. Once only I found a nest (with ten eggs) in the fissure of a rock on the Kentucky river, a few miles below Frankfort. Generally however the holes to which they betake themselves are either over deep swamps, above cane-brakes, or broken branches of high sycamores, seldom more than 40 or 50 feet from the water. They are much attached to their breeding places, and for three successive years I found a pair near Henderson, in Kentucky, with eggs in the beginning of April, in the abandoned nest of an ivory-billed woodpecker. The eggs, which are from six to fifteen, according to the age of the bird, are placed on dry plants, feathers, and a scanty portion of down, which I believe is mostly plucked from the breast of the female. They are perfectly smooth, nearly elliptical, of a light colour between buff and pale green, two inches in length by one and a half in diameter; the shell is about equal in firmness to that of the mallard's egg, and quite smooth. No sooner has the female completed her set of eggs than she is abandoned by her mate, who now joins others, which form themselves into considerable flocks, and thus remain apart until the young are able to fly, when old and young of both sexes come together, and so remain until the commencement of the next breeding season. In all the nests which I have examined, I have been rather surprised to find a quantity of feathers belonging to birds of other species, even those of the domestic fowl, and particularly of the wild goose and wild turkey. On coming upon a nest with eggs when the bird was absent in search of food, I have always found the eggs covered over with feathers and down, although quite out of sight in the depth of a woodpecker's or squirrel's hole. On the contrary, when the nest was placed in the broken branch of a tree, it could easily be observed from the ground, on account of the feathers, dead sticks, and withered grasses about it. If the nest is placed immediately over the water, the young, the moment they are hatched, scramble to the mouth of the hole, launch into the air with their little wings and feet spread out, and drop into their favourite element; but whenever their birthplace is at some distance from it the mother carries them to it one by one in her bill, holding them so as not to injure their yet tender frame. On several occasions however when the hole was thirty, forty, or more yards from a bayou or other piece of water, I observed that the mother suffered the young to fall on the grasses and dried leaves beneath the tree, and afterwards led them directly to the nearest edge of the next pool or creek."

D. galericulata and *D. sponsa* breed freely in captivity. Both species have produced several broods in the Gardens of the Zoological Society in the Regent's Park, where most of the *Anatinæ* are exhibited. The latter has also bred in St. James's Park, where they and other *Anatinæ* may be always seen.

Mandarin Duck (*Dendronessa galericulata*), male.

Colonel Sykes, in his 'Catalogue of Birds observed in the Dukhun' (Deccan), enumerates the following British *Anatinæ*—*Anas strepera*, Linn., males identical with specimens in the British Museum, from

Kent; no females for comparison; numerous in Dukhun; *Rhynchaspis virescens*, Leach, Manuscripts, *Anas clypeata*, Linn.; identical with British specimens of the common Shoveler, but differing from the description of that bird in Shaw; *Mareca fistularis*, Steph., *Anas Penelope*, Linn., Widgeon, absolutely identical with specimens from Devonshire; *Querquedula Circia*, Steph., *Anas Circia*, Linn., Garganey, identical with British specimens; *Querquedula crecca*, *Anas crecca*, Linn., Common Teal, identical with male and female British specimens.

Mr. Keith Abbott ('Zool. Proc.,' 1834), in his 'List of Trebizond Birds,' ennmerates *Anas Boschas*, Linn., the Mallard, as almost universal; and *A. Querquedula*, Linn., which is noted as inhabiting India as well as Europe, and as common in the Himalaya range.

The sub-family *Fuligulinæ* includes the genera *Somateria*, *Oidemia*, *Fuligula*, *Clangula*, and *Harelda*.

The *Fuligulinæ*, or Sea-Ducks, as they have been not inaptly named, frequent the sea principally; but many of them are to be found in the fresh-water lakes and rivers where the water is deep. The plumage is very close and thick in comparison with that of the True Ducks (*Anatinæ*), and the covering of the female differs much in hue from that of the male, which when adnlt undergoes but little change in its dress from the difference of season. The young resemble the female in their feathered garb, and do not assume the adult plumage till the second or third year. Moulting takes place twice a year, without change of colour. In the male the capsule of the trachea is large.

The Sea-Ducks are not good walkers, on account of the backward position of their feet, but they run, or rather shuffle along rapidly, though awkwardly. They swim remarkably well, though low in the water, and excel in diving, whether for amusement, safety, or food, which last consists of insects, mollusks, the fry of fish, and marine or other aquatic vegetables. They take wing unwillingly as a security from danger, relying more confidently on their powers of diving and swimming as the means of escape than on those of flight. Though they are often strong, steady, rapid, and enduring in their passage through the air, they generally fly low, laboriously, and with a whistling sound.

This sub-family may be considered to be monogamous, and the nest is frequently made near the fresh waters; the female alone incubating, though both parents, in several of the species at least, strip the down from their breasts as a covering for the eggs, which are numerous.

The North may be considered the great hive of the *Fuligulinæ*; though some of the forms are spread over the greater part of the globe. Large flocks are seen to migrate periodically, keeping for the most part the line of the sea-coast, and flying and feeding generally by night, though often, especially in hazy or blowing weather, by day.

Somateria (Leach).—Bill small, with the base elevated and extending up the forehead, where a central pointed line of feathers divides it; the anterior extremity narrow but blunt; nostrils mesial; neck thick; wings short; tertiaries long, and generally with an outward curve, so as to overlie the primaries. Tail moderate, consisting of 14 feathers.

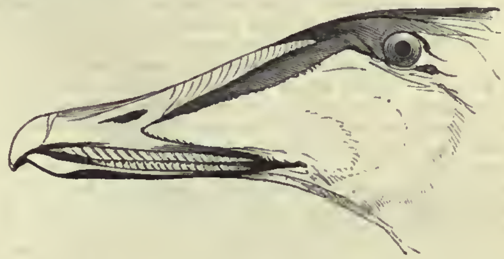
This genus is peculiarly marine. Sir John Richardson, whose opportunities of observing the northern birds were so great and so well used, says that *Somateria spectabilis* and *S. mollissima* are never, as he believes, seen in fresh water; their food consisting mostly of the soft *Mollusca* in the Arctic Sea. They are, he says, only partially migratory, the older birds seldom moving farther southward in winter than to permanent open water. He states that some Eider-Ducks pass that season on the coast of New Jersey, but that the King-Ducks (*S. spectabilis*) have not been seen to the southward of the 59th parallel. Audubon however says that in the depth of winter the latter have been observed off the coast of Halifax in Nova Scotia, and Newfoundland, and that a few have been obtained off Boston, and at Eastport in Maine.

The genus is remarkable for the high development of the exquisitely soft and elastic down so valuable in commerce, and so essential to the keeping up of the proper balance of animal heat in the icy regions inhabited by these birds.

S. mollissima (*Anas mollissima*, Linn.), the Eider-Duck. This is the Oie à Duvet ou Eider of the French; Eider-Gans and Eiter-Ente of the Germans; Oca Settentrionale of the Italians ('Stor. degli Ucc.'); the Eider-Goose, Eider-Duck, St. Cuthbert's Duck, Cuthbert Duck or Cutbert Duck, Great Black and White Duck, and Colk Winter Duck, of the British; Hwyad fwythblu of the Welsh; Dunter Duck of the Hudson's Bay residents; and Mittek of the Esquimaux.

The following is Sir John Richardson's description of a male killed June 14, 1822, at Winter Island, 66° 11½′ N. lat.:—Circumference of the frontal plates, forehead, crown, and under eye-lid, deep Scotch blue; hind head, nape, and temples, siskin-green. Stripe on the top of the head, cheeks, chin, neck, breast, back, scapulars, lesser coverts, curved tertiaries, sides of the rump, and under wing-coverts, white; the tertiaries tinged with greenish-yellow, and the breast with buff. Greater coverts, quills, rump, tail and its coverts, and the under plumage, pitch black; the end of the quills and tail fading to brown. Bill, oil-green. Legs, greenish-yellow.

The bill is prolonged on the lengthened depressed forehead into two narrow flat plates that are separated by an angular projection of the frontal plumage. Nostrils not pervious. Neck short and thick. Wings nearly three inches shorter than the tail. Hind toe attenuated posteriorly into a broad lobe. The length of this bird was 25 inches 6 lines. The female is pale rufous or yellowish brown with black bars; wing-coverts black with ferruginous edges; greater coverts and secondaries with narrow white tips; head and upper part of the neck striped with dusky lines; beneath, brown with obscure darker blotches.



Bill of Eider-Duck (*Somateria mollissima*).

The young at the age of a week are of a dark mouse-colour, thickly covered with soft warm down.

The young male is like the female; and does not appear in the full adult male plumage till the fourth year.

The icy seas of the north appear to be the principal localities of this species. Colonel Sabine enumerates it among the animals which were met with during the period in which the expedition under Captain Parry remained within the arctic circle. He mentions it as abundant on the shores of Davis's Strait and Baffin's Bay; but adds that, deriving its food principally from the sea, it was not met with after the entrance of the ships into the Polar Ocean, where so little open water is found. The females were without the bands on the wings described by authors. ('Appendix to Captain Sir W. E. Parry's First Voyage,' 1819-20.) Captain Lyon saw the Eider in Duke of York's Bay. ('Journal.') Sir James Ross ('Appendix to Captain Sir John Ross's Last Voyage') notices vast numbers of the King-Duck as resorting annually to the shores and islands of the arctic regions in the breeding season, and as having on many occasions afforded a valuable and salutary supply of fresh provision to the crews of the vessels employed in those seas. Speaking of the Eider-Duck he says it is so similar in its habits to the King-Duck that the same remarks apply equally to both. In Lapland, Norway, Iceland, Greenland, and at Spitzbergen, the Eider-Duck is very abundant; and it abounds also at Behring's Island, the Kuriles, the Hebrides, and Orkneys. In Sweden and Denmark it is said to be more rare, and in Germany to be only observed as a passenger. Temminck states that the young only are seen on the coasts of the ocean, and that the old ones never show themselves. Sir James Ross, in the 'Appendix' above alluded to, speaking of the eider-down, says that the down of the King-Duck is equally excellent, and is collected in great quantities by the inhabitants of the Danish colonies in Greenland, forming a valuable source of revenue to Denmark. A vast quantity of this down, he adds, is also collected on the coast of Norway and in some parts of Sweden. The Eider-Duck is found throughout Arctic America, and is said to wander in severe winters as far south to sea as the capes of the Delaware. From November to the middle of February small numbers of old birds are usually seen towards the extremities of Massachusetts Bay and along the coast of Maine. A few pairs have been known to breed on some rocky islands beyond Portland, and M. Audubon found several nesting on the island of Grand Manan in the Bay of Fundy. Prince Bonaparte notes it as rare and adventitious in the winter at Philadelphia. The most southern breeding-place in Europe is said to be the Fern or Farn Isles on the coast of Northumberland.

Willughby, quoting Wormius, says that the Eider-Ducks "build themselves nests on the rocks, and lay good store of very savoury and well-tasted eggs; for the getting of which the neighbouring people let themselves down by ropes dangerously enough, and with the same labour gather the feathers (Eider-Dun our people call them), which are very soft and fit to stuff beds and quilts; for in a small quantity they dilate themselves much (being very springy), and warm the body above any others. These birds are wont at set times to moult their feathers, enriching the fowlers with this desirable merchandise." Willughby also remarks that "when its young ones are hatched it takes them to the sea, and never looks at land till next breeding time, nor is seen anywhere about our coasts." This early account is in the main correct, but there are two kinds of eider-down—the live-down, as it is termed, and the dead-down; the latter, which is considered to be very inferior in quality, is that taken from the dead bird. The down of superior quality, or live-down, is that which the duck strips from herself to cherish her eggs. Its lightness and elasticity are such, it is asserted, that two or three pounds of it squeezed into a ball which may be held in the hand, will swell out to such an extent as to fill a case large enough for the foot covering of a bed. It is collected in the following manner:—The female is suffered to lay her five or six eggs, which are about three inches in length and two in breadth. These, which are very palatable, are taken, and she strips herself a second time to supply the subsequent eggs. If this second batch be abstracted, the female being unable to supply any more down, the male plucks his breast, and his contribution is known by its pale colour. The last deposit, which rarely consists of more than two or three eggs, is always left; for if deprived of this their last hope the bereaved birds forsake the inhospitable place; whereas, if suffered to rear their young, the parents return the following year with their progeny. The quantity of down afforded by one female during the whole period of laying is stated at half a pound neat, the quantity weighing nearly a pound before it is cleansed. Of this down Troil states that the Iceland Company sold in one year (1750) as much as brought 850*l.* sterling, besides what was sent to Glückstadt.

Eider-Duck (*Somateria mollissima*), male and female.

The haunts of birds capable of producing so valuable an article are not unlikely to be objects of peculiar care. We accordingly find that in Iceland and Norway the districts resorted to by them are reckoned valuable property, and are strictly preserved. Every one is anxious to induce the Eiders to take up their position on his own estate; and when they show a disposition to settle on any islet the proprietor has been known to remove the cattle and dogs to the mainland in order to make way for a more valuable stock which might be otherwise disturbed. In some cases artificial islets have been made by separating promontories from the continent; and these eider-tenements are handed down from father to son like any other inheritance. Notwithstanding all this care to keep the birds undisturbed, they are not, as we shall presently see, scared by the vicinity of man, in some places at least. We proceed to give the personal observations of some of those who have visited eider-settlements:—"When I visited the Farn Isles," writes Pennant (it was on the 15th of July, 1769), "I found the ducks sitting, and took some of the nests, the base of which was formed of sea-plants and covered with the down. After separating it carefully from the plants it weighed only three-quarters of an ounce, yet was so elastic as to fill a larger space than the crown of the greatest hat. These birds are not numerous on the isles, and it was observed that the drakes kept on those most remote from the sitting-places. The ducks continue on their nests till you come almost close to them, and when they rise are very slow flyers. The number of eggs in each nest was from three to five, warmly bedded in the down, of a pale olive colour, and very large, glossy, and smooth." Horrebow declares that one may walk among these birds while they are sitting without scaring them; and Sir George Mackenzie, during his travels in Iceland, had an opportunity, on the 8th of June at Vidöe, of observing the Eider-Ducks, at all other times of the year perfectly wild, assembled for the great work of incubation. The boat in its approach to the shore passed multitudes of these birds, which hardly moved out of the way; and between the landing-place and the governor's house it required some caution to avoid treading on the nests, while the drakes were walking about even more familiar than common ducks, and uttering a sound which was like the cooing of doves. The ducks were sitting on their nests all round the house, on the garden wall, on the roofs, nay even in the inside of the houses and in the chapel. Those which had not been long on the nest generally left it when they were approached; but those that had more than one or two eggs sat perfectly quiet and suffered the party to touch them, though they sometimes gently repelled the intrusive hand with their bills. But if a drake happen to be near his mate when thus visited he becomes extremely agitated. He passes to and fro between her and the suspicious object, raising his head and cooing.

M. Audubon saw them in great numbers on the coast of Labrador—where, by the way, the down is neglected—employed about their nests, which they begin to form about the end of May. They arrive there and on the coasts of Newfoundland about the first of that month. The eggs were of a dull greenish-white, and smooth, from 6 to 10 in number. The nest was usually placed under the shelter of a low prostrate branched and dwarf fir; and sometimes there were several under the same bush, within a foot or two of each other. The ground-work of the nests consisted of sea-weeds and moss, and the female did not add the down till the eggs were laid. The duck, having at this time acquired an attachment for her eggs, was easily approached, and her flight was even and rather slow. Audubon states that, as soon as incubation has commenced, the males leave the land, and join together in large flocks out at sea: they begin to moult in July, and soon become so bare as to be scarcely able to rise from the water. By the 1st of August, according to the same author, scarcely an Eider-Duck was to be seen on the coast of Labrador. The young, as soon as hatched, are led by the female to the water, where they remain, except at night and in stormy weather. Their greatest feathered enemy is the Saddle-Backed Gull, or Black-Backed Gull (*Larus marinus*), which devours the eggs and young, but whose pursuit the young, after they have left the nest, elude by diving, at which both old and young are very expert.

According to Brunnich and others, the male utters a hoarse and moaning cry at the pairing time, but the cry of the female is like that of the common duck. Both sexes assist in forming the nest, though the female only sits: but the male watches in the vicinity, and gives notice of the danger. This seems to be confirmed by the account given of the nesting-place at Vidöe. Sometimes two females deposit their eggs in the same nest, and sit amicably together. The gulls are not their only enemies in addition to man, for the ravens often suck their eggs and kill their young. At sea, several hatches congregate, led by the females, and there they may be seen splashing the water in the shallows, to beat up the small crustaceans and mollusks, and diving in deeper water for the larger marine animals, among which muscles and other conchifers, turbinated testaceans, and occasionally Sea-Eggs (*Echini*) are said to be taken.

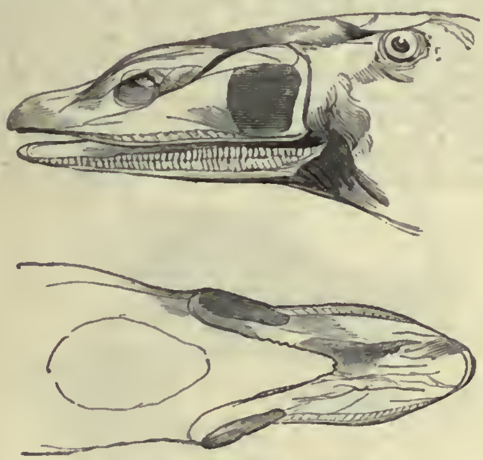
The down above described is the principal tribute paid by the Eider-Duck to man: but the Indian and Greenlander eat the flesh, which is dark and fishy, and their skin is converted into a warm inner garment. According to Sir W. E. Parry, the Esquimaux Indians catch these birds with springes made of whalebone, and take the eggs wherever they can find them. The skin, prepared with the feathers on, forms an article of commerce, particularly with the Chinese. M. Audubon is of opinion that if this valuable bird were domesticated, it would prove a great acquisition, both on account of its down, and its flesh as an article of food; and he is persuaded that very little attention would effect this. Indeed, it appears that the experiment was made at Eastport with success, but the greater number of the ducks were shot, being taken by gunners for wild birds. The same author says that, when in captivity, it feeds on different kinds of grain and moistened corn-meal, when its flesh becomes excellent. Mr. Selby succeeded twice in rearing Eiders from the egg, and kept them alive upwards of a year, when they were accidentally killed.

Oidemia (Fleming).—Bill broad with dilated margins, and coarse lamelliform teeth, gibbous above the nostrils, which are nearly mesial, large, and elevated; tail of 14 feathers.

The *Oidemiæ* seek their food at sea principally; and have obtained the name of Surf-Ducks, from frequenting its edge. The prevailing colour of the tribe is black in the male, and brown in the female. The plumage is very thick and close; and, according to Audubon, the down in the Velvet-Duck (*Oidemia fusca*) is similar to that of the Eider-Duck, and apparently of equal quality. Their flesh is high-flavoured and oily, according to Sir John Richardson, who gives that character to the flesh of three species, namely, *O. perspicillata*, *O. fusca*, and *O. nigra*. The two former, according to that enterprising zoologist, breed on the arctic coasts, migrate southward in company with *Clangula* (*Harelda?*) *glacialis*, halting both on the shores of Hudson's Bay and on the lakes of the interior, as long as they remain open, and then feed on tender shelly *Mollusca*. *O. nigra*, he adds, frequents the shores of Hudson's Bay, and breeds between the 50th and 60th parallels. It was not seen in the interior.

O. perspicillata, *Anas perspicillata* of Linnæus, the Black or Surf-Duck. This is the Macreuse à Large Bec, ou Marchand, and Canard Marchand, of the French; the Black-Duck, of Pennant; and the Great Black-Duck from Hudson's Bay of Edwards.

The male is velvet black, with a reddish reflection; throat brownish; a broad white band between the eyes, and a triangular patch of the same on the nape; bill reddish-orange, the nail paler; a square black spot on the lateral protuberance; legs orange; webs brown; bill much like that of the Velvet-Duck (*O. fusca*), but the lateral protuberances are naked and horny, and the central one is feathered farther down; the laminæ are distant, and the lower ones particularly prominent, with cutting edges. As in the other *Oidemiæ*, the bill and forehead are inflated, causing the head to appear lengthened and the crown depressed; the nostrils are rather large, and nearer to the point than to the rictus. Length 24 inches. (Richardson.)



Bill of Surf-Duck (*Oidemia perspicillata*).

The female and young are of a black ashy brown wherever the male is deep black. Head and neck lighter; frontal band and great angular space upon the nape indicated by very bright ashy brown. Lateral protuberances of the bill but little developed, and the whole bill of an ashy yellowish colour. Feet and toes brown; webs black. (Temminck.) Sir John Richardson observes that the under plumage in particular is paler, that the back and wing-coverts are narrowly edged with gray, that the breast, flanks, and ears have some whitish edgings, that the bill is black, its base not so much inflated, and that the nostrils are smaller than in the male.

This bird is rare and accidental in the Orcades, and in the higher latitudes towards the pole; very rare in the cold and temperate countries bathed by the ocean; very common and numerous in America, at Hudson's and Baffin's Bays. Such is Temminck's account. Nuttall says that this species of duck, with other dark kinds commonly called on the other side of the Atlantic 'coots,' may be properly considered as an American species; its visits in the Orkneys and European seas being merely accidental. They breed on the arctic coasts, and extend their residence to the opposite side of the continent, having been seen at Nootka Sound by Captain Cook. The bird is not mentioned in the notice of the animals which were met with during the period in which the expedition remained within the arctic circle, appended to Captain Sir W. E. Parry's 'First Voyage,' nor in Captain James Ross's 'Appendix to Captain Sir John Ross's Last Voyage.' Prince Bonaparte notes it as very common, and most abundant in the sea in the neighbourhood of the shore at Philadelphia.

In summer the Surf-Duck feeds principally in the sea, and haunts shallow æstuaries, bars, and bays, where it may be seen constantly diving for its shelly food. The surf is a favourite station with it. Hudson's Bay and Labrador are among its breeding places, and the nest is formed of grass with a lining of down or feathers, on the borders of fresh-water ponds. The eggs are white, and from four to six in number. The young are hatched in July, and detained on the borders of the ponds, where they were excluded from the egg, until they are able to fly. Their migrations extend to Florida, but they often remain throughout the winter along the shores and open bays of the United States. At the end of April or early in May they again proceed northward.

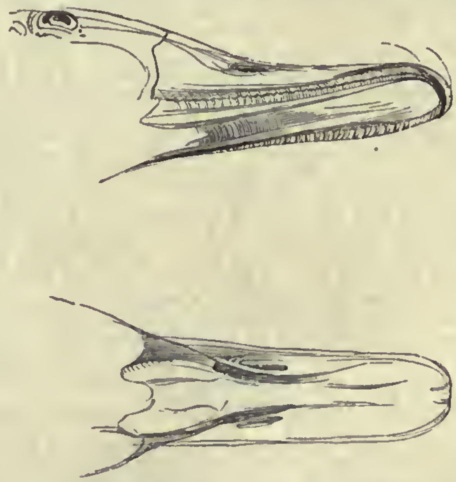
Surf-Duck (*Oidemia perspicillata*), male.

The flesh of the old birds is very dark, red, and fishy when dressed; the young are of better flavour. They are however often eaten by the inhabitants of the coasts frequented by them; and being difficult to approach, they are decoyed by means of a wooden figure of a duck of the same general appearance with themselves.

Fuligula (Ray).—Bill flat, broad, long, with hardly any gibbosity at the base, and rather dilated at the extremity. Nostrils suboval, basal. Tail short, of 14 feathers, graduated laterally. First quill longest.

The sea, and its bays and æstuaries, are the principal haunts of this genus. Sir John Richardson states that *F. Valisneria*, *F. ferina*, *F. marila*, and *F. rufitorques*, breed in all parts of the Fur Countries, from the 50th parallel to their most northern limits, and associate much on the water with the *Anatinæ*. *F. rubida*, he remarks, frequents the small lakes of the interior up to the 58th parallel, and he adds that it is very unwilling to take wing, and dives remarkably well. In swimming, according to the same observer, it carries its tail erect, and, from the shortness of its neck, nearly as high as its head, which, at a little distance, causes it to appear as if it had two heads.

F. Valisneria (*Anas Valisneria* of Wilson), Canvass-Back-Duck. The male has the region of the bill, top of the head, chin, base of the neck, and adjoining parts of the breast and back, rump, upper and



Bill of Canvass-Back Duck (*Fuligula Valisneria*).

under tail-coverts, pitch-black; sides of the head and the neck reddish-orange; middle of the back, scapulars, wing-coverts, tips of the secondaries, tertiaries, flanks, posterior part of the belly and thighs, grayish-white, finely undulated with hair-brown; primaries and their coverts hair-brown, their tips darkest; secondaries ash-gray, tipped with white; the two adjoining tertiaries edged with black. Belly white, faintly undulated on the medial line. In some specimens the white parts are glossed with ferruginous. Bill and legs blackish-brown. The bill is lengthened, the depressed frontal angle longer, the nostrils farther from the front, and the unguis differently shaped and smaller than in *F. ferina* (the Pochard); the upper laminæ flat, cuneate, not prominent, and confined within the margin of the mandible. The bill and head of the Canvass-Back approach somewhat to the form of the Pintail-Duck, being much lengthened, and of equal breadth throughout. First quill the longest. Length, 24 inches 6 lines.

The female has the ground-colour of the upper plumage and flanks liver-brown; sides of the head, neck, and breast, ferruginous; shoulders, shorter scapulars, and under plumage, edged with the same. Middle of the back and wing-coverts clove-brown, finely undulated with grayish-white. There are no undulated markings on the tertiaries and secondaries, and only a few on the tips of the scapulars. Bill as in the male; the neck more slender. (Richardson.)

Canvass-Back-Duck (*Fuligula Valisneria*).

It breeds from the 50th parallel to the most northern limits of the Fur Countries. When the work of incubation is past, flocks of Canvass-Backs pursue their course to the southward, and arrive about the middle of October on the sea-coasts of the United States. The Hudson, the Delaware, and the bays of North Carolina, are visited by some of these flocks; and it is stated that they are abundant in the river Neuse, in the vicinity of Newbern, and probably in most of the other southern waters down to the coast of the Gulf of Mexico, being seen in winter in the mild climate of New Orleans, at which season a few pairs arrive in Massachusetts Bay, near Cohaset and St. Martha's Vineyard. But it is to Chesapeake Bay, its æstuaries and rivers, among which the Susquehanna, the Patapsco, James's River, and the Potomac, may be particularly mentioned, that the great multitude of Canvass-Back-Ducks resort. (Wilson; Nuttall.)

The Canvass-Backs associate with the Pochards, and are waited upon by the Bald-Pates or Widgeons (*Mareca Americana*), which rob them in the manner already described. They are named in different parts of the Union White-Backs and Sheldrakes, as well as Canvass-Backs. *Zostera marina* and *Ruppia maritima* form their food, as well as the fresh-water *Valisneria*, which last is limited in its distribution. The Sea-Wracks or Eel-Grass, as the long marine vegetables above alluded to are called in America, are widely spread over the Atlantic, and over the mud-flats, bays, and inlets where salt or brackish water finds access. The Canvass-Backs dive for and generally pluck up the sea-wrack, and feed only on the most tender portion near the root. They are very shy birds, and most difficult to be approached. Various stratagems are resorted to for getting within gunshot of them; and in severe winters artificial openings are made in the ice, to which the ducks crowd, and fall a sacrifice to their eagerness to obtain food. That they will eat seeds and grain as well as sea-wrack, &c., was proved by the loss of a vessel loaded with wheat near the entrance of Great Egg Harbour, New Jersey, to which great flocks of Canvass-Backs were attracted. Upon this occasion as many as 240 were killed in one day. (Wilson; Nuttall.)

The Canvass-Back, which is lean on its first arrival in the United States, becomes, in November, about three pounds in weight, and in high order for the table: there are few birds which grace the board better. Prince Bonaparte is eloquent in its praise:—"Carne della massima squisitezza, grandemente ricercata dai gastronomi. La migliore delle Anitre. Forse il miglior uccello d'America." Any attempt to introduce the bird into England would, it is feared, prove a failure; for even if the ordinary difficulties should be got over, the absence of the food to which it is supposed to owe its exquisite flavour would render the success of the experiment very doubtful.

Clangula (Boié).—Bill narrow, elevated at the base, somewhat attenuated at the anterior extremity, and short. Nostrils inclining to oval, submesial, or rather anterior to the middle of the bill. Tail rather long, of 16 feathers generally.

Though many of this genus frequent the sea, the species are more generally met with in the fresh waters than the other Sea-Ducks. Thus, Sir John Richardson remarks that *C. vulgaris* (Common Golden-Eye) and *C. albeola* (Spirit-Duck) frequent the rivers and fresh-water lakes throughout the Fur Countries in great numbers. They are, as he states, by no means shy, allowing a near approach to the sportsman; but at the flash of a gun, or even at the twang of a bow, they dive so suddenly that they are seldom killed. Hence the natives impute supernatural powers to them, as the appellations of 'Conjuring Ducks' and 'Spirit-Ducks' sufficiently testify. Richardson says that the manners of *C. Barrovii* (Richardson and Swainson), described in 'Fauna Boreali-Americana,' and which has hitherto been found only in the valleys of the Rocky Mountains, do not differ from those of the Common Golden-Eye. He speaks of *C. histrionica* as haunting eddies under cascades and rapid streams, as very vigilant, taking wing at once when disturbed, as rare, and as never associating, as far as he saw, with any other bird. The high northern latitudes may be considered generally as the localities of this genus.

C. albeola, the Spirit-Duck, *Anas albeola* of Linnæus. It is the Buffel-Duck of Pennant; the Buffel's-Head-Duck of Catesby; the Little Black and White Duck of Edwards; the Buffel-Headed Duck of Wilson; Wakaishee-Weesbeep, Waw Haisheep, and Wappano-Sheep, of the Cree and Chippeway Indians.

The male has the forehead, region of the bill, nuchal crest, and upper sides of the neck, rich duck-green, blending with the resplendent auricula-purple of the top of the head and throat. Broad band from the eye to the tip of the occipital crest, lower half of the neck, the shoulders, exterior scapulars, intermediate and greater coverts, outer webs of five or six secondaries, flanks, and under plumage to the vent, pure white. Back, long scapulars, and tertiaries, velvet black; lesser coverts bordering the wing the same, edged with white; primaries and their coverts brownish black. Tail-coverts blackish-gray; tail broccoli-brown. Vent and under tail-coverts grayish. Bill bluish-black. Legs yellowish. In many spring specimens the under plumage is ash-gray. The bill smaller in proportion than that of the common Garrot, and the nostrils nearer the base; but otherwise similar. Head large, with the upper part of the neck clothed in velvety plumage, rising into a short thick crest. Wings $2\frac{1}{2}$ inches shorter than the tail. Tail—lateral feathers graduated, three middle pairs even. Length 16 inches; but individuals differ in size.

Bill of Spirit-Duck (*Clangula albeola*).

The female is considerably smaller. Head and dorsal plumage dark blackish-brown; the fore part of the back, scapulars, and tertiaries, edged with yellowish brown. Fore part of the neck, sides of the breast, flanks, and vent-feathers, blackish-gray; breast and belly white, glossed with brownish-orange. White band on the ears and occiput much narrower than in the male. The white speculum is less perfect, and the whole of the lesser coverts and scapulars are unspotted blackish-brown. Bill and feet brownish. Total length $14\frac{1}{2}$ inches. Young males resemble the females. (Richardson.)

This bird is abundant in the summer on the rivers and fresh-water lakes of the Fur Countries. In autumn and winter very common in the United States, sometimes on the sea-shores. Catesby says that the Buffel's-Head-Duck appears in Carolina during the winter only. On the river Neuse, in North Carolina, they have been seen in abundance in February. In April and May those in the south take their departure northward.

This species is a most expert diver, whether it resorts to that feat as a mode of escape, or as the means of procuring the sea-wrack and laver (*Ulva lactuca*), and crustaceans and mollusks, which, at particular seasons of the year when it visits the sea-bays and salt marshes, form its favourite food. The rapidity of its disappearance from the surface, and the artful way in which it conceals itself after it has vanished under water, have earned for it the appropriate name of 'Spirit-Duck,' or 'Conjurer.' A bird is rarely hit, and when it is, if not killed outright, it can rarely be captured; so quick is the Spirit-Duck in avoiding the shot altogether, and so dexterous in evading its pursuer, if only wounded. About Hudson's Bay they are said to form their nests in hollow trees in woods adjacent to water. (Wilson; Nuttall.)

The flesh of the Spirit-Duck is not in high repute, but the females and young are tender and well flavoured in the winter. The bird becomes so fat that, in Pennsylvania and New Jersey, it is commonly called 'Butter-Box,' or 'Butter-Ball.'

Spirit-Duck (*Clangula albeola*), male and female.

C. vulgaris, Anas Clangula Linn., the Common Golden-Eye, or Garrot, is an inhabitant of the arctic regions of the New and Old Worlds, and is frequently met with in this country, and in Europe generally. The species is distributed over the Swiss lakes. Mr. Gould figures *C. Barrovii* and *C. histrionica* among the Birds of Europe, the former having been shot in Iceland by T. C. Atkinson, Esq., and the latter having been frequently captured in the British Islands.

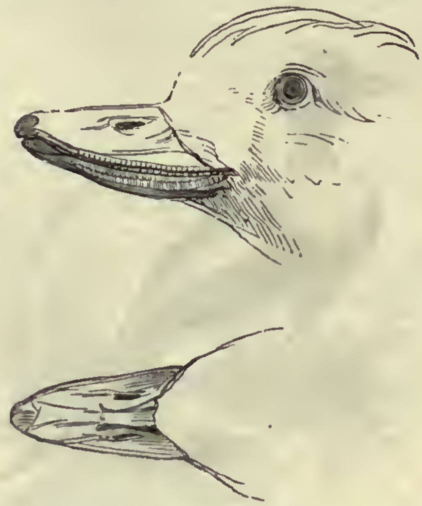
Harelda (Leach).—Bill very short, high at the base, nail broad and arched. Laminæ prominent, trenchant, and distant; the upper laminæ projecting below the margin of the mandible, the lower laminæ divided into a nearly equal double series. Nostrils oblong, large, and nearly basal. Forehead high; neck rather thick. Tail very long, of 14 feathers. Toes short.

H. glacialis, Anas glacialis, Linn., the Long-Tailed Duck. This is the Canard à Longue Queue, ou Canard de Miclon, of the French; Eis-Ente, Winter-Ente, of the Germans; Ungle, Angeltaske, Trasfoener, of the Norwegians; Oedel of the Faroe Islanders; Ha-Old, Ha-Ella, of the Icelanders; Swallow-Tailed Sheldrake, Sharp-Tailed Duck, Calao, Calaw, Coal and Candle Light, of the English; Hwyad gynffon gwennol of the Welsh; Old Wife and Swallow-Tailed Duck of the Hudson's Bay residents; South-Southerly of the United States; Aldiggee-areoo of the Esquimaux; Caccåwee of the Canadian voyagers; and Hahhaway of the Cree Indians.

The old male in winter has the summit of the head, nape, front, and lower parts of the neck, long scapulars, belly, abdomen, and lateral tail-feathers, pure white; cheeks and throat ash-colour; a great space of maroon-brown on the sides of the neck; breast, back, rump, wings, and the two long feathers of the middle of the tail, brownish; flanks ash-coloured; the black of the bill cut transversely by a red band; tarsi and toes yellow; webs blackish; iris orange. Length, comprising the long tail-feathers, 20 to 21 inches.

The old female differs much from the male. Tail short, the feathers bordered with white and the two middle ones not elongated; forehead, throat, and eyebrows, whitish-ash; nape, front, and lower part of the neck, belly, and abdomen, pure white; top of the head and great space at the sides of the neck blackish ash; breast variegated with ash-colour and brown; feathers of the back, scapulars, and wing-coverts, black in the middle, bordered and terminated with ashy-red; rest of the other parts brown; the bluish colour of the bill cut by a yellowish band; iris bright brown; feet lead-colour. Length 16 inches.

The young of the year do not differ much from the old female; the whiteness of the face is varied with numerous brown or ash-coloured spots; throat, front of the neck, and nape, ashy-brown; lower part of the neck, a large spot behind the eyes, belly, and abdomen, white; breast and thighs variegated with brown and ash-coloured spots. (Temminck.)



Bill of Long-Tailed Duck (*Heralda glacialis*).

The summer dress of the male is as follows:—The whole upper plumage, the two central pairs of tail-feathers, and the under plumage to the fore part of the belly brownish-black; the lesser quills paler. A triangular patch of the feathers between the shoulders, and the scapulars, broadly bordered with orange-brown. Sides of the head from the bill to the ears ash-gray; eye-stripe and posterior under-plumage pure white. Flanks, sides of the rump, and lateral tail-feathers, white, stained with brown; axillaries and inner wing-coverts clove-brown. Bill black, with an orange belt before the nostrils. Legs dark-brown. Specimens killed a fortnight or three weeks later in the season at Bear Lake, on their way to the breeding-places, differed in having a large white patch on the hind head and occiput, with scattered white feathers on the neck and among the scapulars; the sides under the wings pure pearl-gray, and the sides of the rump unstained white. (Richardson.)

Colonel Sabine ('Supplement to Appendix of Captain Sir W. E. Parry's First Voyage') notices a male obtained in June, corresponding precisely with the individual killed in Baffin's Bay in the summer of 1818, which furnished the description of the full breeding plumage in the 'Memoir of the Greenland Birds.' Sir John Richardson observes that Colonel Sabine describes the plumage of the specimens killed at Bear Lake as the pure breeding plumage; but individuals coloured like the one killed on the Saskatchewan are, he remarks, often seen at the breeding stations. He quotes Mr. Edwards, surgeon of the Fury ('Sir W. E. Parry's Second Voyage'), as describing the Long-Tailed Ducks killed at Melville Peninsula between the 1st and 25th of June as follows:—"They had all a dark silky chestnut-brown patch on the side of the neck; a mixture of white in the black stripe from the bill to the crown; the crown and nape either entirely white, or mixed with black; scapulars and upper tail-coverts edged with white; a broad white collar round the lower part of the neck, in some individuals tipped with black or brown; occasionally a white band on the breast. The colour of the belt on the bill varied from rose-red to violet."

A mature female, killed May 25, lat. 65° 30′, had the upper plumage and sides of the breast pale liver-brown, with dark centres; the wing-coverts, scapulars, and hinder parts, mostly edged with white. Top of the head blackish-brown, its sides anteriorly broccoli-brown; ears and base of the neck below clove-brown. A spot at the base of the bill and a stripe behind the eye white. Throat and collar ash-gray. Tail-feathers brownish-gray, edged with white, short and worn. (Richardson.)

This bird is found in the arctic seas of both worlds; an accidental visiter on the great lakes of Germany, and along the Baltic; often but never in flocks, on the maritime coasts of Holland. (Temminck.) Abundant in Sweden, Lapland, and Russia. (Gould.) Noted in the list of birds seen within the arctic circle, and as breeding in the North Georgian Islands, but not common there. ('Supplement to Appendix to Captain Parry's First Voyage.') Females taken in Duke of York's Bay. (Captain Lyon's 'Journal.') Abundant on the Arctic Sea, associating with the *Oidemiæ*, remaining in the north as long as it can find open water, and assembling in very large flocks before migrating; halts, during its progress southward, both on the shores of the Hudson's Bay and in the inland lakes, and is one of the last of the birds of passage which quits the Fur Countries. Captain Sir James Ross describes it as the most noisy and most numerous of the ducks that visit the shores of Boothia. The species is abundant in Greenland, Lapland, Russia, and Kamtchatka, and flocks pass the winter (from October to April) at the Orkney Islands. They are seldom seen in the southern parts of England, unless the weather be very severe. In October they visit the United States, and abound in Chesapeake Bay.

Long-Tailed Duck (*Harelda glacialis*), male and female.

Lively, most noisy, and gregarious, the Long-Tailed Duck, with its swallow-like appearance in flight, swims and dives with all the expertness of the Spirit-Ducks. Sir John Richardson states that in the latter end of August, when a thin crust of ice forms during the night on the Arctic Sea, the female may be often seen breaking a way with her wings for her young brood. The same author states that the eggs are pale greenish-gray, with both ends rather obtuse, 26 lines long and 18 lines wide. They are about five in number; and in Spitzbergen, Iceland, and along the grassy shores of Hudson's Bay, near the sea, this species is said to form its nest about the middle of June, lining the interior with the down of the breast. Marine productions principally, both animal and vegetable, form its food, particularly the *Zostera*, or Grass-Wrack, for which it dives like others of its congeners. "Late in the evening, or early in the morning," writes Nuttall in his 'Manual of the Ornithology of the United States and of Canada,' "towards spring more particularly, vast flocks are seen in the bays and sheltered inlets, and in calm and foggy weather we hear the loud and blended nasal call reiterated for hours from the motley multitude. There is something in the sound like the honk of the goose, and, as far as words can express a subject so uncouth, it resembles the guttural syllables ogh, ough, egh, and then ogh, ogh, ogh, ough, egh, given in a ludicrous drawling tone; but still, with all the accompaniments of scene and season, this humble harbinger of spring, obeying the feelings of nature, and pouring forth his final ditty before his departure to the distant north, conspires, with the novelty of the call, to please rather than disgust those happy few who may be willing to find 'good in everything.'"

The old birds are not considered as of much value for the table; but the young birds are tender and juicy. If, as is on good authority asserted, the down which the Long-Tailed Duck strips from its breast as a lining for the nest, is as soft and elastic as that of the Eider-Duck, it may be considered as offering no mean contribution to the comforts of man, a contribution which, however apparently hitherto neglected, deserves the attention of the intelligent and enterprising.

In addition to the genera above mentioned, *Gymnura* (*Oxyura*, Bonaparte), *Macropus*, and *Micropterus* find a place among the Sea-Ducks.

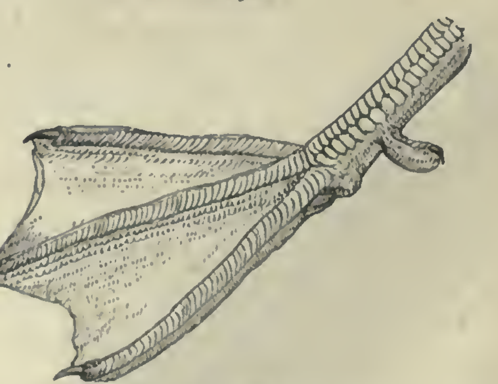
The species from which the genus *Oxyura* is established, is bred, according to Nuttall ('Manual'), in the north, and principally haunts fresh-water lakes, diving and swimming with great ease, but it is averse to rising into the air. It is small, and is said by the last-named author to be nearly allied to *Anas leucocephala*, which inhabits the saline lakes and inland seas of Siberia, Russia, and the east of Europe; and also to have an affinity to *A. Jamaicensis* of Latham. Nuttall thinks that it is perhaps identical with *A. spinosa* of Guyana, if not also with *A. Dominica* of Gmelin, a native of St. Domingo, and probably only resident there during the winter. He also observes that the name of *Oxyura* having been previously employed for a sub-genus of Creepers, it was necessary to alter it; but the student should remember that *Gymnura* had been pre-occupied by Sir Stamford Raffles for a genus of Mammifers; and that Spix has named a family of South American Monkeys *Gymnuri*. Prince C. L. Bonaparte, however, corrected himself, and changed the name to *Erismatura*. Mr. Gould gave the name of *Undina* to the genus, and figures the European species under the name of *Undina leucocephala*. The term *Macropus* has long been applied as a generic name for the Kangaroos.

Micropterus is the genus containing the well-known Race-Horse of Cook (*Micropterus brachypterus*, *Anas brachyptera* of authors). Captain Philip Parker King, R.N., who has added a second species (*Micropterus Patachonicus*), gives these short-winged but rapidly-progressing Sea-Ducks the familiar name of Steamer-Ducks or Steamers.

The sub-family *Merganinæ* (*Merginæ*, Bonap.), consists of the genus *Mergus*, Linn., the Goosanders or Mergansers of the British. Prince Bonaparte makes it include two sub-genera, *Mergus* (the Smew) and *Merganser*, Leach (the Goosander), and places the sub-family next to the *Fuligulinæ*, and immediately preceding the *Pelecanidæ*. In the second volume of Mr. Swainson's 'Classification of Birds,' the sub-family is placed after the *Fuligulinæ*, and immediately preceding the family *Colymbidæ*.

Merganser (Leach).—Bill straight, narrow, and slender, sub-cylindrical anteriorly, wide at the base, and abruptly hooked at the tip;

Bill of *Merganser*.



Foot of the same.

margins of both mandibles serrated, the serrations or teeth directed backwards. Tongue slender. Feet short, with the toes fully palmated, and placed behind the point of equilibrium.

M. castor (*Mergus Merganser* and *castor* of Linnæus), the Goosander. This species is the Sugherone of the Italians; the Meer-Rack aud See-Rack of the Germans; Wrakfogel, Kjorkfogel, Ard, and Skraka, of the 'Fauna Sueeica;' Skallesluger of the Danes; Skior-And of the Icelanders; Peksok of the Greenlanders; Seek of the Cree Indians; Hwyad ddanhe-dog of the Welsh; and Jack-Saw of the English. It is supposed to be the Κάστορος Ὄρνις of the Greeks; the *Fiber* and *Castor Ales* of the Latins; and is the Bieure of the old French.

The very old male has a tufted head (the tuft large and thick), aud part of the neck greenish-black, the reflection varying in different lights; lower part of the neck, breast, belly, abdomen, coverts of the wings and scapulars farthest from the body, tinged of a yellowish-rose-colour (which soon fades in stuffed specimens to white) on the under parts; upper part of the back and scapulars nearest to the body deep black; quills blackish; great coverts bordered with black; rest of the back and tail ash-coloured; beauty-spot on the wing white, without transverse bands; bill deep red, black above and on the terminal tail; iris reddish-brown, sometimes red; feet vermilion-red. Length 26 to 28 inches. (Temm.)

In this plumage the bird is the *Mergus Merganser* of Linnæus and others; Le Harle of Buffon and the French; the Goosander or Mersander of Latham and Pennant; Gansen-Säger and Taucher-Gans of Bechstein and the Germans; Mergo, Oca Marina e Mergo Dominicano, of the 'Stor. degl. Ucc.;' and Dubbelde Zaagbek of Sepp. and the Netherlanders.

The female has a long and looso tuft; head and part of the neck reddish-brown; throat pure white; lower part of the neck, breast, sides, and thighs whitish-ash; all the upper parts deep ash; beauty-spot of the wing white, without any transverse band; bill faded red; iris brown; feet yellowish-red; webs ashy-red. Length 24 or 25 inches.

The young males of the year are similar to the females.

The young at the age of one year are distinguished by blackish spots disposed on the white of the neck; the ruddy colour of the neck is then terminated by a deeper colour; blackish plumes begiu to show themselves on the top of the head, and white feathers appear on the coverts of the wings.

In this state the bird is the *Mergus castor* of Linnæus and others; *Mergus rubricapillus* of Gmelin; the Harle Femelle of Buffon; the Dun Diver or Sparling Fowl of Latham and others; and the Mergo Oca of the 'Stor. degl. Ucc.'

Goosander (*Mergus Merganser*, Linn.).
Lower figure, male; upper figure, female.

The food of the Goosander consists of small fish, crustaceans and mollusks. Temminck says that its nest is placed among rolled pebbles on the banks of waters, in bushes or in hollow trees, and that it lays twelve or fourteen whitish eggs, which are nearly equally pointed at each end. The flesh is very rank and bad. Graves, who tasted one, pronounces it to have been offensive in the highest degree. The old French quatrain in the 'Portraits des Oyseaux,' gives the following description of its habits and of its quality as food:—

Le Bieure scait aux estangs se plonger
Pour le poisson, auquel est dommageable.
Mais qui vouldroit festoyer un diable,
Fauldroit vn Bieure avoir pour son manger.

Mr. Gould ('Birds of Europe') states that "its nativo locality appears to be the northern regions of the continents of Europe and America, where among large and unfrequented lakes it finds an asylum and breeding-place; from these, its summer haunts, it emigrates southwards on the approach of the severities of winter, seldom appearing in our latitudes unless the season indicates an exceedingly low temperature in the arctic circle: at such times it frequents our shores and unfrozen lakes either in pairs or in small flocks of seven or eight; but the extensive inland waters of Holland and Germany appear to be its favourite resort." This species was shot at Fulham in the severe winter of 1837. It appears in Sir John Richardson's list of birds that they merely winter in Pennsylvania and migrate in summer to rear their young in the Fur Countries; the specimen described by him was killed on the Saskatchewau. It also occurs in Colonel Sabine's list of Greenland Birds. Prince Bonaparte notes it as rather rare in winter in Rome, and as not common in the same season in Philadelphia ('Specchio Comparativo'), and as occurring in Europe generally, and in America generally, in his 'Geographical and Comparative List of the Birds of Europe and North America.' It was seen in Japan by Dr. Von Siebold and M. Bürger.

Mergus.—Bill about as loug, or longer, than the head, straight, slender, rather pointed; the base large, forming an elongated and almost a cylindrical cone; point of the upper mandible curved, aud with the horny nail forming a hook; edges of both mandibles furnished with saw-like teeth, the poiuts directed backwards. Nostrils lateral, about the middle of tho beak, lougitudinally elliptic. Legs short, placed rather backwards; three toes in front, webbed, hiud toe with a lobe or membrane. Wings moderate; the first and second quill-feathers nearly equal in length.

M. albellus. The old male has a great spot of grecuish black on each side of the bill, a similar coloured but longitudinal one on the occiput; the tufted crest, neck, scapulars, small coverts of the wings, and all the lower parts, very pure white; upper part of the back, the two crescents which are directed under the sides of the breast, and the edges of the scapulars, deep black; tail ash-coloured; sides and thighs varied with ash-coloured zig-zags; bill, legs (tarsi), and toes, bluish-ash webs black; iris brown. Length 15 to 16 inches.

Mergus albellus. Upper figure, male; lower figure, female. (Gould.)

In this state the bird is *M. albellus* of Linnæus and others; Le Petit Harle Huppé ou La Piette of Buffon; the Weiser Sager of Bechstein and others; the Witte non Duiker of Sepp.; the Mergo Oca Minoro of the 'Stor. degl. Ucc.;' and the Smew or White Nun of the English ornithologists.

The female has the summit of the head, cheeks, aud occiput, reddish-brown; throat, upper part of the neck, belly, and abdomeu, white; lower part of the neck, breast, sides, and rump, bright ash; upper parts and tail deep ash; wings variegated with white, ash, and black. Length 15 inches.

Young of the year, similar to the female.

The males at the age of one year are distinguished by the small blackish feathers which form the great spot at the side of the bill; by some whitish and white feathers scattered on the head; by the upper part of the back, which is variegated with black and ash-coloured feathers; and by indications of the two black crescents ou the side of the breast. The young of both sexes have the great coverts of the wings terminated by a large white space, while the old ones have no white there except at the point.

The females and young of the year are the *Mergus minutus*, Linn.; *M. Asiaticus*, Gm.; *M. stellatus*, Brunn.; *M. Pannonicus*, Scop.; La Piette Femelle, Buff.; Le Harle Etoilé (young male), Buff.; Mergo Oca Minore (female), and Mergo Oca Cenerino (young male of the year), 'Stor. degl. Ucc.;' De Kleine Zaagbek (young of the year), Sepp.; and Red-Headed Smew (young male in moult), Penn., 'Brit. Zool.'

This species is the Kreutz-Ente of Frisch and the Germans; the Hviid Side of the Danes; Sugherone Occhialino of the Italiaus; Lleian wen of the Welsh; Smew and White Nun, Vare Widgeon, and Smec, of tho English.

The food of the Smew consists of small crustaceans, water-insects, mollusks, little fish, and water-plants. The nest, according to M. Temminck, is placed on the borders of rivers and lakes, and the number of eggs amounts to twelve; they are whitish. The bird is in no request for the table.

The countries of the arctic circle in both worlds are the habitations of the Smew. It is migratory in autumn, but especially in winter, in England, Holland, France, and as far as Italy; rather abundant in Holland on the lakes and marshes. (Temm.) It is seldom seen in Britain except in inclement winters. The species was not observed by Sir John Richardson, but it is noted by him in the tables compiled from the 'Specchio Comparativo' as one of the birds that migrate northward from or through Pennsylvania in spring, and may therefore be considered as returning to the Fur Countries to breed. Prince Bonaparte notices it as rather common in winter, particularly the young, near Rome, and as very rare and adventitious at Philadelphia. (Specchio Comparativo.') The same author, in his 'Geographical and Comparative List,' notes it as occurring in Europe generally and on the northern and central coasts of America. Dr. Von Siebold and M. Bürger found it in Japan.

M. Temminck remarks that the Harles, or birds of this sub-family, live upon the waters, where they swim, having generally the whole of the body submerged, and only the head out of the water; but this is certainly not the case with the Smew, as it swims with a very fair proportion of its body above the surface. They dive easily and often, swim with extreme agility 'entre deux eaux', and use their wings to assist them in this sort of natation. They remain long on wing, and fly very swiftly. Their walk is very vacillating and embarrassed, their legs or feet, as well as those of the Sea-Ducks, being more withdrawn within the abdomen than those of the ducks which have the posterior toe smooth. Their food consists principally of fish and amphibious animals, and of the first they make great destruction. In temperate climates they are only seen in winter; their habitual dwelling is in cold countries, where they breed. They are much wilder than the different species of ducks, and have not been domesticated. They moult once a year; but the old males, like those of the ducks, moult in the spring, whilst the old females and the young moult in the autumn. The young males, before their first or second moult, hardly differ at all from the females.

The following list of British *Anatidæ* is made up from the 'Catalogue of the Specimens of British Animals in the British Museum.' The catalogue of birds in this collection has been drawn up by Mr. George Robert Gray.

Family *Anatidæ*.

Sub-Family I. *Plectropterinæ*.

Plectropterus.

P. Gambensis, the Spur-Winged Goose.

Sub-Family II. *Anserinæ*.

Chenalopex.

C. Ægyptica, the Egyptian Goose.

Bernicla.

1. *B. leucopsis*, the Bernicle-Goose.
2. *B. Brenta*, the Brent-Goose.
3. *B. ruficollis*, the Red-Breasted Goose.
4. *B. Canadensis*, the Canada Goose.

Anser.

1. *A. ferus*, the Gray-Lag Goose.
2. *A. segetum*, the Bean-Goose.
3. *A. brachyrhynchus*, the Pink-Footed Goose.
4. *A. erythropus*, the White-Fronted Goose.
5. *A. cygnoides*, the Chinese Goose.

Sub-Family III. *Cygninæ*.

Cygnus.

1. *C. ferus*, the Whistling Swan.
2. *C. Americanus*, the American Swan.
3. *C. olor*, the Mute Swan.
4. *C. immutabilis*, the Changeless Swan.
5. *C. minor*, Bewick's Swan.

Sub-Family IV. *Anatinæ*.

Tadorna.

1. *T. vulpanser*, the Common Shieldrake.

Casarka.

1. *C. rutila*, the Ruddy Shieldrake.

Mareca.

1. *M. Penelope*, the Widgeon.
2. *M. Americana*, the American Widgeon.

Dafila.

1. *D. acuta*, the Pintail Duck.

Anas.

1. *A. Boschas*, the Wild Duck.

Querquedula.

1. *Q. crecca*, the Teal.
2. *Q. bimaculata*, the Bimaculated Duck.

Pterocyanea.

1. *P. circia*, the Garganey.

Aix.

1. *A. sponsa*, the Summer-Duck.

Chaulelasmus.

1. *C. strepera*, the Gadwall.

Spatula.

1. *S. clypeata*, the Shoveler.

Cairina.

1. *C. moschata*, the Muscovy Duck.

Sub-Family V. *Fuligulinæ*.

Branta.

1. *B. rufina*, the Red-Crested Whistling-Duck.

Fuligula.

1. *F. cristata*, the Tufted Duck.
2. *F. collaris*, the Collared Duck.
3. *F. marila*, the Scaup-Duck.

Nyroca.

1. *N. ferina*, the Pochard.
2. *N. ferinoides*, Paget's Pochard.
3. *N. leucophthalmos*, the Ferruginous Duck.

Clangula.

1. *C. glaucion*, the Golden Eye.
2. *C. histrionica*, the Harlequin-Duck.
3. *C. albeola*, the Buffel-Headed-Duck.

Harelda.

1. *H. glacialis*, the Long-Tailed Duck.

Eniconetta.

1. *E. Stelleri*, the Western Duck.

Somateria.

1. *S. mollissima*, the Eider-Duck.
2. *S. spectabilis*, the King's Duck.

Oidemia.

1. *O. fusca*, the Velvet-Scoter.
2. *O. nigra*, the Common Scoter.
3. *O. perspicellata*, the Surf-Scoter.

Sub-Family VI. *Merginæ*.

Mergus.

1. *M. castor*, the Goosander.
2. *M. serrator*, the Red-Breasted Merganser.
3. *M. cucullatus*, the Hooded Merganser.

Mergellus.

1. *M. albellus*, the Smew.

Most of the species referred to in the foregoing article may be seen living in the Gardens of the Zoological Society, Regent's Park. Some years ago an Ornithological Society was formed in London, and obtained permission to place their living collection of birds upon the waters in St. James's Park. The specimens of *Anatidæ* in this collection are very numerous and worthy the attention of the ornithological student. We are indebted to the keeper of the birds for the following list:—

The Black Swan.	Aylesbury Duck.
Bewick's Swan.	Hook-Billed Duck.
Hooper-Swan.	Muscovy Duck.
Common Swan.	Buenos Ayres Duck.
Common Goose.	Yellow-Billed Duck.
Chinese Goose.	Carolina Duck.
Egyptian Goose.	Castaneous Duck.
Brent-Goose.	Golden-Eye Duck.
Bernicle-Goose.	Pintail Duck.
Bean-Goose.	Pochard.
Canada Goose.	Gadwall.
Sandwich Island Goose.	Shieldrake.
Spur-Winged Goose.	Common Widgeon.
Goosander.	Common Teal.
Common Duck.	

There are also specimens of birds belonging to the family *Colymbidæ* in the same collection.

DUCK-WEED. [LEMNA.]

DUDLEY LIMESTONE, an equivalent term for the Wenlock Limestone of the Silurian system. [SILURIAN SYSTEM.]

DUFRENITE, a Mineral, occurring in small radiated masses. Its colour is olive or dull green. It is slightly translucent and extremely fusible. The specific gravity is 3·227. It is found at Anglar, near Limoges. The following is an analysis:—

Phosphoric Acid	24·8
Protoxide of Iron	51
Peroxide of Manganese	9
Water	15—99·8

DUFRENOYSITE, a Mineral, consisting of an arseniuret and sulphuret of lead. It occurs in dodecahedrons of a dark steel-gray colour in the Dolomite of St.-Gothard. The specific gravity is 5·55.

DUGONG [CETACEA.]

DUIKER-BOK. [ANTILOPEÆ.]

DULCAMARA. [SOLANUM.]

DULSE. [ALGÆ.]

DUMB-CANE. [AROIDEÆ; CALADIUM.]

DUNDIVER. [DUCKS.]

DUNLIN. [SCOLOPACINÆ.]

DUNNOCK. [SYLVIADÆ.]

DUODE'NUM (from a Latin word signifying twelve, because it is twelve inches in length), the first of the small intestines in immediate connection with the stomach. It commences at the pyloric end of the stomach, and terminates at the distance of twelve inches in the second portion of the small intestines called the jejunum. Though it is the straightest of the small intestines, yet the Duodenum describes in its course various turns. From the pylorus it turns backwards and upwards by the neck of the gall-bladder, with which it is in contact; it then passes obliquely downwards on the right side immediately before the great vessels which enter the liver. Opposite to the under part of the kidney it makes a turn to the left side, across the lumbar vertebræ, and is lodged in the common root of the mesocolon and mesentery, below the pancreas and behind the superior mesenteric vessels; it now makes a turn forwards, and obtains the name of jejunum.

The Duodenum is much more capacious than the jejunum or ilium, and is indeed so large that it has been regarded as a second stomach, and obtained the name of Ventriculus Succenturiatus. It is fixed much more closely to the spinal column than the other intestines, and does not, like them, float loosely in the abdomen. It is of a redder colour than the rest, has a thicker muscular coat, and a greater number of valvulæ conniventes.

At the distance of from three to four fingers' breadth from the pylorus the Duodenum is perforated by the biliary and pancreatic ducts, by which tubes the bile and the pancreatic juice flow into the intestine.

The Duodenum is probably an organ accessory to the stomach. There is evidence that it carries on the digestion commenced in the stomach. It is certain that alimentary substances which have escaped solution in the stomach are dissolved in the Duodenum.

The chyme formed from the food in the stomach and received by the Duodenum, retains the name of chyme until it reaches that portion of the Duodenum where the biliary and pancreatic ducts pierce the intestine. At this point, and by the admixture of the biliary and pancreatic juices, the chyme is changed into two portions—into a nutritious portion, which receives the name of chyle and which flows into the blood [CHYLE]; and into an excrementitious portion, which is carried along the small into the large intestines, where it receives the name of fæces, and is expelled from the body.

On the surface of the Duodenum the lacteal vessels begin to make their appearance for the absorption of the chyle. [LACTEALS.] The Duodenum is likewise provided with a great number of mucous glands, which more especially abound near the pylorus. [GLANDS.]

DURA-MATER. [BRAIN.]

DURA'MEN, the name given by physiologists to the central wood or heart-wood, in the trunk of an exogenous tree. It is the oldest part of the wood, and is filled by the secretions of the tree, so that fluid can no longer ascend through its tubes, which are choked up by the deposition of solid matter; otherwise it is of the same nature as the alburnum. It is only where plants form solid hard secretions that heart-wood is distinguishable from sap-wood: in the poplar, willow, lime, &c., no secretions of this kind are formed; the two parts of the wood are both nearly alike, and consequently the timber of such trees is uniformly perishable. Ship-carpenters call the Duramen the spine: it is always distinguishable from sap-wood by its deeper colour, and sometimes, as in the yew, the sandarach, and certain kinds of deal, the limits of the two are clearly defined. But in most cases the heart-wood and sap-wood gradually pass into each other, so that no certain line can be drawn between them. [ALBURNUM; EXOGENS; TISSUES, VEGETABLE.]

DU'RIO, a genus of Plants of which the name has been derived from Durion, a well-known fruit of the Malayan Archipelago. The specific name of *Zibethinus* has been applied to the tree which forms this genus, from the fondness of the Malayan Zibet (*Viverra Rasse*, Hors.) for this fruit.

The genus *Durio* belongs to the natural family of *Bombaceæ*, considered by some botanists to be only a tribe of *Sterculiaceæ*. It is characterised by having its five petals smaller than the five lobes of the calyx. The stamens, long and numerous, are arranged in five bundles, and have twisted anthers; the free germen is surmounted by a long filiform style and capitate stigma; the fruit, roundish and muricated, is divided internally into five cells, and easily separates when ripe into five parts; each cell contains from two to four or five seeds enveloped in soft pulp.

D. Zibethinus is a large and lofty tree, with alternate leaves, which are small in proportion to its size; in form they resemble those of the cherry, or are oblong-pointed, small and green above, like nutmeg-tree leaves, but on the under surface are covered with orbicular reddish-coloured scales, as some species of *Capparis*; the petioles are tumid, and furnished with a pit towards their base; the flowers are arranged in clusters on the trunk and older branches, where of course is also borne the fruit, as in the Jack and Cocoa trees.

The Durion is a favourite food of the natives during the time (May and June) when it is in season; but there is usually also a second crop in November. It is as remarkable for the delicacy combined with richness of its flavour, as for the intolerable offensiveness of its odour, which is compared by Rumph to that of onions in a state of putrefaction, on which account it is seldom relished by strangers, though highly esteemed by many European residents. In size it is equal to a melon, or a man's head, and sometimes compared to a rolled-up hedgehog (hence it has been called *Echinus arboreus*) in consequence of its hard and thick rind, which is yellow-coloured when ripe, being covered with firm and angular projections. From this appearance has likewise been derived its Malayan name, 'dury' in that language signifying a thorn or prickle. (Rumph.)

The seed, with its edible enveloping pulp, is about the size of a hen's egg; the latter is as white as milk, and as delicate in taste as the finest cream, and should be eaten fresh, as it soon becomes discoloured, and undergoes decomposition. Excessive indulgence in this, as in other fruits, is apt to create sickness, and therefore to its abundance has been sometimes ascribed the unhealthiness of some years; but as the crop of fruit is most abundant when the rains are very heavy and follow great heats, the sickness is probably due as much to the peculiarities of the season as to the too free use of this fruit.

The seeds of the Durion are likewise eaten when roasted, and have something of the flavour of chestnuts. The wood of the tree is valued for many economical purposes, especially when protected from moisture. The rind of this fruit is likewise turned to account by the industrious Chinese, as its ashes, when burnt, probably from containing potash, are used by them in the preparation of some dyes.

Marsden, in his account of Sumatra, quotes a celebrated writer as saying that "Nature seems to have taken a pleasure in assembling in the Malay Islands her most favourite productions." Among these may be enumerated the Mangosteen, the Jack and Bread-Fruit trees, the Lanseh, and Durion, with others which are common in other tropical parts. These it has not been possible to cultivate in the hot-houses of England, even with all the skill of its horticulturists; a circumstance which must be ascribed partly to the great size of the trees, and partly to the peculiarity in climate of 'India aquosa,' as this part of the world was called by old writers. But as it is only within a few years that moisture has been combined with heat in the present successful cultivation of Orchideous Plants, it might perhaps be possible to make some of the above fruits grow in a similar artificial climate; and, by grafting, to make them bear when only a few feet high, as has been done with the Mango in India.

DUTCH WHITE. [BARYTES.]

DUVAUA. [ANACARDIACEÆ.]

DYKE (in Geology), a fissure caused by the dislocation of strata, commonly also termed a Fault. Dykes are of frequent occurrence, and often extend several miles, penetrating generally to an unknown depth. They must have been produced by some violent disturbances, and the amount of dislocation of necessity would vary in proportion to the intensity of the disturbing force. Accordingly there are many dykes of great width and extent, which materially affect the face of the country in which they occur, while there are others so slight that it requires much care and observation to ascertain their existence. The strata are in most cases uplifted on one side of the dyke much higher (varying many fathoms) than those on the other side, and produce an apparent irregularity of strata most perplexing to the geologist. Sometimes it happens that, without any irregularity of surface, two distinct strata appear to form a continuous line, as in the Black Down Hills in Devonshire. [CHALK FORMATION.] In some cases however dislocation is found without any alteration of the level of the strata on either side, but the appearance of the strata immediately adjacent to the fault sometimes affords proof of the action of fire. [COAL FORMATION.] Dykes are of two distinct characters, depending upon the manner in which they have been filled up, and the substance of which they are composed. Dykes of the first description are those into which igneous rocks are supposed to have been injected in a state of fusion, and now appear as a consolidated mass. [BASALT.] In the second the fissures are filled with the debris, sometimes mixed with clay, of the dislocated strata through which they pass. In some cases the fissure has evidently remained unoccupied for a long period, and the filling up has proceeded gradually from the sides inwards. This is observed very evidently in the carboniferous limestones of England and Wales. Sometimes, in consequence of the great length of time intervening between the production of each coating of calcareous matter, the outside of each is covered with crystals, upon which the next layer has been formed: in the central portions of such fissures cavities are by no means uncommon.

DYNASTES, a genus of Coleopterous Insects belonging to the section *Pentamera*, sub-section *Lamellicornes*, and family *Dynastidæ* of M'Leay. The species have the body very large and thick, the outer edge of the jaws sinuated or toothed, and the lower jaws corneous and toothed. The genus *Dynastes* embraces the largest and most robust forms of the insect kingdom. They are, nevertheless, quite harmless. None of the species are found in this country, and only one in France. The largest forms are found in the tropical parts of India and South America. The habits of these insects are much the same wherever found. They bury themselves by day in holes in the ground, or in the decaying trunks of trees. At night they are seen flying about the trees. The females are more numerous than the males, and do not possess the horns, which give the males so remarkable an appearance. The more remarkable species of this genus are the Elephant and Hercules Beetles. The latter is of a glossy black colour. In the males the thorax is developed into a thick and curved horn, which is bent downwards at the tip, a similar horn projects from below which points upwards, so as to come in contact with the former. The entire length of this beetle is 6 inches.

DYNO'MENE, a genus of Brachyurous *Crustacea* belonging to the division *Notopoda*, founded by Latreille. The ocular pedicles longer than those of *Dromia*. The shell is wide, nearly heart-shaped and truncated posteriorly, hairy or bearded. The two posterior feet only dorsal, and much smaller than the others.

D. hispida, the only species known to M. Latreille, is found in the Isle of France.

Dynomene hispida.

DYSCHIRIUS. [CLIVINA.]

DYSCLASITE, a Mineral consisting of hydrous silicate of lime. It occurs in white fibrous masses, consisting of delicate fibres of a whitish or yellowish or bluish colour. It has a hardness of 4·5, and a specific gravity of from 2·28 to 2.36. It is easily gelatinised in hydrochloric acid. It is found in the trap of the Faroe Islands. A variety called *Okenite* is from Greenland.

DYSDERA, a genus of Spiders. The species have 6 eyes, placed in a curve resembling a horse-shoe open in front; the mouth-claws very large, and produced in front; the maxillæ straight, and dilated at the place of insertion of the palpi. The type of the genus is *D. erythrina*, which is not an uncommon species in Great Britain. It is mostly found under stones.

DYSLUITE, a Mineral, a variety of *Spinel*. It occurs crystallised in regular octohedrons. Its cleavage is rather imperfect, parallel with the faces of the octohedron. The colour is yellowish-brown or grayish-brown. Fracture conchoidal. Hardness 4·5. Somewhat translucent, opaque. Lustre vitreous, inclining to resinous. Specific gravity, 4·551. It is found at Sterling, New Jersey, with *Franklinite* and *Troostite*. The following is an analysis by Dr. Thomson :—

Alumina	30·490
Oxide of Zinc	16·800
Peroxide of Iron	41·934
Protoxide of Manganese	7·600
Silica	2·966
Moisture	0·400

It becomes red before the blowpipe, but loses its colour on cooling.

DYSODIL. [COAL.]

DYSOPUS. [CHEIROPTERA.]

DYTI'SCIDÆ, a tribe of Pentamerous Coleopterous Insects, founded on the genus *Dytiscus* of Linnæus. It now includes the following genera :—*Pelobius, Matus, Coptotomus, Eunectes, Agabus, Ilybius, Colymbetes, Acilius, Hydaticus, Dytiscus, Cybister, Copelatus, Anisomera, Laccophilus, Noterus, Hydrocanthus*, and *Suphis*.

The insects composing these genera are almost all oval and flattened in form. They are very variable in size, some being very minute, others several inches in length. Their four posterior extremities are longer than the anterior, flattened, and ciliated. They are all aquatic insects, and organised for swimming, though at the same time capable of flying through the air with facility. They live in fresh water, and swim with great rapidity, chasing other water-insects, and seizing them with their anterior feet. Although capable of existing a long time under water, they are obliged to ascend at intervals to the surface to breathe. This they effect by remaining quiet, when their bodies, specifically lighter than the surrounding fluid, rise to the surface obliquely, their heads downwards, so that the extremity of the abdomen, at which the stigmata of the tracheæ are situated, is exposed to the air on reaching the surface. At night they fly from one pool to another, and hence are often met with in places flooded by temporary rains. The larvæ of the *Dytiscidæ* leave the water and bury in the earth before changing into pupæ. Thus they are at first aquatic insects, next terrestrial, and in their final stage amphibious.

The typical genus *Dytiscus* has engaged the attention of Dr. Aubé, who enumerates ten European, one African, and six American species.

DZEGGUETAI. [EQUIDÆ.]

DZEREN. [ANTILOPEÆ.]

E

EAGLE. [FALCONIDÆ.]

EAGLE-WOOD, one of those substances of which the name, from similarity of sound in a foreign language, has been converted into another having no reference to its original signification. It is a highly fragrant wood, much esteemed by Asiatics for burning as incense, and known in Europe by its present designation ever since the Portuguese visited and imported the substance direct from the Malayan islands and the kingdom of Siam, where it has always been abundant, and long established as an article of commerce. The Malayan name is Agila, whence the wood was called Pao-d'Agila by the Portuguese, and has since been converted into Pao-d'Aguila, and Pao-d'Aquila, Bois-d'Aigle, Eagle-Wood, and Agel-Hout.

From the Malayan Agila has probably been derived the Sanscrit Agara, whence we have the Hindoo Aggur, if not from the more familiar appellation of Garoo, by which Eagle-Wood is also known in the Malayan Archipelago. In Persian works on Materia Medica in use in India, we learn from Dr. Royle ('Illustr. of Himal. Bot.' &c.) that several kinds of fragrant wood are described under the Arabic name Aod (Haud and Ud of Garcias), and that he himself obtained three kinds in the bazaars of India, called Aod-i-Hindee, Aod-i-Chinee, and Aod-i-Kimaree (evidently the Al-Cemericum of Arabian authors); and that with the above Hindoo a Greek synonym, Agallochee, is also given, and more especially applied to Aod-i-Kimaree, which is also called Aod-i-Bukhoor, Incense-Wood. As Agallochee is no doubt a corruption of the Agallochum of Dioscorides, described by him as a fragrant wood from India and Arabia, it is interesting to find that the translators from the Greek into the Arabic of the school of Baghdad settled these synonyms at a time when they must have been well acquainted, from their profession and position, with the substances to which both the Greek and Arabic names were applied. Serapion and Avicenna describe several kinds of this fragrant wood, and the latter under both Agalugen or Aghaloojee, and Aod, which in the Latin version is translated Xyloaloe, a name that was applied by the later Greek medical writers to Agallochum, whence we have lignum aloes, lign-aloe, and aloes-wood, the origin of which it is difficult, if not impossible, to ascertain, unless we suppose it to be a corruption of Agila; for the bitter, scentless, spongy-textured stems of the genus Aloe could not afford any substitute for this fragrant wood, or be thought to yield it, at least by the Arabs, who were well acquainted with and accurately describe aloes, and the place, Socotra, where the best kind is found. Though Dioscorides notices only one, which some supposed to be the Tarum of Pliny, several kinds of Agallochum are described by Serapion and Avicenna, which, as it is not possible at present to identify, it is unnecessary to notice, and therefore we shall refer only to the three kinds which have been traced to the trees yielding them, by naturalists who have visited the countries where these are indigenous.

An *Aguila brava* (wild) is mentioned by Garcias as produced near Cape Comorin, in the southern part of the Indian peninsula, and in the island of Ceylon; but the tree yielding this wood has not been ascertained. Rumphius ('Herb. Amb.' ii. p. 40), describes two kinds of *Agallochum spurium*, found in Borneo and Sumatra, one of which he calls Garo Tsjampaca, which is described as having leaves and flowers resembling those of the celebrated Champa (*Michelia champaca*), and may be a species of the same genus. A third kind of spurious Agallochum, differing much from the others as well as from the genuine, he describes in another part of his work, ii. p. 240, as the produce of his *Arbor excæcans*, so called from the acridity of its juice blinding people, and which is the *Excæcaria agallocha* of Linnæus. Considering that Rumphius, in originally describing this tree, has said 'Lignum hoc tantam cum agallocha similitudinem,' and as affording a substitute for that substance, it is not surprising that it should be frequently quoted as the tree which yields the genuine agallochum, or aloes-wood. Fée ('Hist. Nat. Pharm.') states that he had seen a genuine specimen of the wood of this tree, and that its fragrance cannot be compared with the agallochum of Loureiro. Dr. Roxburgh mentions that the wood-cutters of the delta of the Ganges, though well acquainted with the highly acrid and very dangerous milky juice of this tree (there called geria), do not mention agallochum of any kind being found in this tree.

Of the two kinds of Agallochum which are most valued, and both considered genuine, one is distinguished by the name of Calambac, and the other as the Garo of Malacca.

The first, called Calambac, and Agallochum Primarium by Rumphius, appears, as far as hitherto known, to be a native of Cochin-China only, growing on the mountains of that country iu about 13° N. lat., near the great river Lavum, which may be the Meikeng flowing between Cochin-China and the Laos. This tree was named *Aloexylum agallochum* by Loureiro, 'Fl. Cochin-Chinensis,' p. 327, and placed by him in *Decandria Monogynia*, and described as a lôfty tree with erect stem and branches, long lanceolate shining leaves, terminal bunches of flowers, with a woody falcate 1-seeded pod for its fruit, whence it is referred by De Candolle to the natural family of *Leguminosæ*. Loureiro states that the wood of this tree is white and inodorous, and that its fragrance is the result of disease, when the oily portions thicken into resin in tho central parts of the tree, and that no part of the trec is milky or poisonous, but that paper is made from its bark in Cochin-China, as in Japan from that of the mulberry.

The next kind of Agallochum is that commonly called Garos, and to which the name of Eagle-Wood is more frequently applied, and which has long been an article of export from Malacca and the kingdom of Siam. Specimens of the tree which yields this were first obtained by M. Sonnerat in his second voyage to India, from which probably have been given the figure and description by Lamarck. ('Enc. Méth.,' 1. p. 49, Illustr. t. 376.) The plant he named *Aquilaria Malaccensis*. This, the Garo de Malacca, was introduced by Dr. Roxburgh into the botanic garden of Calcutta, and was not to be distinguished from specimens of a tree called Ugoon, which is a native of the mountainous tracts east and south-east from Silhet, between 24° and 25° of N. lat., which flowers in April, and ripens its seed in August, and which he says there can be little or uo doubt furnishes the real Calambac or Agallochum of the ancients; adding, that there seems more reason to think that it was carried to China from our eastern frontier, than to suppose it was carried from Cochin-China, or any other country in the vicinity of China, where it has always been in great demand. Small quantities are sometimes imported into Calcutta by sea, from the eastward; but such is always deemed inferior to that of Silhet. ('Fl. Ind.' ii. p. 423.) As the Malacca plant had not flowered, Dr. Roxburgh was unable to decide that they were positively the same with those from Silhet, and therefore named these *Aquilaria agallocha*, as another species of the same genus. By this name it has been figured in Royle's 'Illustr.' i. 36, f. 1, from a drawing by Dr. Hamilton of a plant which he called *Agallochum Officinarum*, and which he found near Goalpara, on the eastern frontier of Bengal. This drawing is illustrated with dissections by Dr. Lindley. [AQUILARIACEÆ.]

The fragrant nature of genuine Agila or Eagle-Wood is well known, and that it has from very early periods been employed both by the natives of India and of China as incense. Mr. Finlayson, in his visit to Siam, says that the consumption of this highly odoriferous wood is very considerable in Siam, but that the greatest part is exported to China, where it is used in a very economical manner. The wood being reduced to a fiue powder, and mixed with a gummy substance, is laid over a small slip of wood, about the size of a bull-rush, so as to form a pretty thick coating. This is lighted, aud gives out a feeblo but grateful perfumo. French authors inform us that the Eagle-Wood was burned as a perfume by Napoleon in the imperial palace.

Wo cannot conclude this subject without inquiring whether the substances of which we have been treating are the Lign-Aloes of Scripture, Ahaloth, masc. Ahel, whose plural is Ahalim. It would bo impossible to do justico to the subject in a small compass, or without referring to the numerous dissertations which have been written on it; but it may be observed, that these might have been much shortened, if the authors had been naturalists, or intimately acquainted with the natural history and usages of eastern countries. Such information would at least have prevented any species of aloe being considered or figured as the far-famed and fragrant Lign-Aloe from a mere similarity in sound. In the present instance, the difficulty is increased by the supposed necessity of reconciling the different passages in which Lign-Aloes are mentioned, as in Numbers, xxiv. 6, where it is mentioned as a tree planted; but in the three other passages, Proverbs, vii. 17, Psalms, xiv. 9, and Canticles, iv. 14, it is enumerated with the most fragrant products of the east, as cinuamon, cassia, calamus, camphor, frankincense, myrrh, spikenard, and saffron. Here we may observe, that a substanco which was indigenous in a country was not likely to have been an article also of commerce from a far country in those early times; and that therefore, as it is disputed whether the word shall be translated Tents or Lign-Aloes, tho word may perhaps be used in a poetical sense, as it is thought to be by some commentators. In tho three passages above referred to, it may be noted that, except sandal-wood, thero is no other substance which could be so well enumerated with those with which it is found in connectiou as the Agila-Wood of the East, whether we consider its high price, delicate perfumo, or the long time in which it has been held in high estimation, while the similarity of its name is at the same time remarkable.

EAR. Many animals unquestionably enjoy the faculty of hearing to a limited extent, which are found, upon examination, to be unprovided with organs exclusively appropriated to the concentration and transmission of sound. In fact, the sense of hearing is, strictly speaking, only a refinement of the sense of touch. The impressions with which it is conversant arise wholly [ACOUSTICS, in ARTS AND SC. DIV.] from peculiar undulations of the particles of ordinary matter, propagated in obedience to its ordinary laws through the medium in which the animal lives, and impinging more or less immediately upon a sensitive part; they have no necessary dependence, like those of sight, upon the agency of the more subtle fluids; nor have they any connection, like those of smell and taste, with what may be called the chemical properties of matter. If to these considerations it be added that the vibratile substances which are commonly found to inclose the sensorium are not ill qualified to participate in the undulations of the surrounding medium, and carry them onwards to the internal seat of perception, the reader will be prepared to learn that tho only essential part of tho organ of hearing is a nerve, uot materially different from those of common sensation, lodged at a sufficient depth to be secured from external injury, and sufficiently sensitive to be affected by these delicate impulses. This is called the acoustic or auditory nerve.

It is probable that even the lowest animals provided with a nervous system are able to perceive the notices thus conveyed of external objects, and turn them to account in the degree necessary for their security and comfort. But to meet the increasing wauts and minister to the multiplied faculties of the more complete animals, various subsidiary parts are found to be added in something like a regular successiou as we advance upwards in the scale, each lower grade possessing the rudiments of some additional provision more fully developed in the next above, till the organ reaches its greatest amplification and final perfection in man and the other *Mammalia*. The particular use of many of these subsidiary parts has not yet been explained. We know in general that they must increase the force and vividness of the impression; that they afford indications of its direction, and the means of appreciating minute shades of difference in its kind and degree, and in the frequency of its repetition; that some of them add to the security of the organ without impairing its delicacy; and that others serve to adjust its position, and to adapt it to various changes in the state of the atmosphere.

The *Radiata* (Sponges, Polyps, &c.), which constitute the lowest, and in point of variety and number by far the most comprehensive division of Cuvier, appear to be universally unprovided with an organ of hearing; many of them have no nervous system, and are therefore probably altogether devoid of the sense. In some of the *Acalephæ* are bodies very like the otolithes found in the higher animals, but whether these are the commencement of an ear or not is doubtful.

The *Articulata*, which form the next division, are all furnished with a nervous system, and it is likely that they all enjoy the sense of hearing. Indeed, some of them are able to express their feelings and wants to their fellows by means of peculiar sounds, of which the cricket and queen-bee are well-known examples. We find accordingly, that in many of the more perfect species the extremity of the acoustic nerve is expanded upon a simple kind of auditory instrument consisting of a whitish membranous bag of fluid, placed within the head in a somewhat larger cavity, the space between them being also occupied by fluid. This cavity is situated near the outer feelers, or antennæ. When the animal lives in water, it is commonly complete; if in air, there is a round external opening closed by a thin tense and transparent membrane, showing the white colour within, to which the bag adheres, and which receives, concentrates, and transmits the sonorous vibrations of the surrounding medium. This kind of arrangement seems to be necessary, among other reasons, for tho purpose of indicating the direction of the sound, which is probably made known in part by the clearer vibration of the membrane when turned in that direction, and in part by a comparison of the impressions ou the two sides; for this organ, like all others which bring the animal into relation with the outer world, is always double and symmetrical. It may be observed that the nerve distributed to the membranous bag just described is given on by that which supplies the antenna with its exquisite sense of touch: some have thought, but perhaps erroneously, that the faculty of hearing resides in the antennæ themselves.

The parts we have enumerated are all found, with others, in the higher animals, and may be considered as the most essential parts of an organ of distinct hearing. The cavity is called the vestibule; the soft membranous bag of fluid is the vestibular sac; the round external opening is called, from its shape in mau and most other animals, the fenestra ovalis; tho fluids within and without the sac are called respectively the endo-lymph and peri-lymph (ἔνδον, within, περί, around); the latter, being analogous to the fluid discovered by Cotugno in the internal ear of *Mammalia*, is sometimes called, after his name, the Liquor Cotunni.

The principal tribes of the *Articulata* ascertained to possess organs of this kind are tho air-breathing insects of tho orders *Hymenoptera* (Bees), *Orthoptera* (Grasshoppers), and *Coleoptera* (Beetles); the *Arachnida* (Spiders), and the *Decapodous Crustacea*, such as the Lobster and Crab. In the common black beetle they aro very conspicuous, appearing externally in the form of round white points on the head, a little nearer the middle line, and somewhat higher than the base of the long outer antennæ. In the lobster they are contained in a small nipple-like prominence or papilla upon the under part of the moveable base of the antennæ, looking downwards and forwards. This papilla consists of a substance harder and more brittle and probably more vibratile than the rest of the shell.

The *Mollusca*, though placed higher in the scale of animals by Cuvier, do not afford so many examples of animals possessing a distinct organ of hearing as the *Articulata*. Such as have been discovered all belong to the order of the Cephalopods with two branchiæ, or gills, which approach more nearly to the true fishes in their structure than the other mollusks.

In the *Sepia*, or Cuttle-Fish, which belongs to this order, and which may be taken as a type of the rest, there is a protuberance under the elastic gristly integument at the back part of the head which contains the ear. It consists of a pair of symmetrical vestibules, each containing an oval sac filled and surrounded with fluid. On the interior surface of this sac the acoustic nerve is expanded in the form of a white mucous pulp. The sac is supported in the perilymph not only by an adhesion to the inner side of the parietes of the vestibule at the entrance of the nerve, but also by a fine net-work of fibrils which pass from its outer surface to numerous prominent points on the inner surface of the vestibule. There is no fenestra ovalis, or membrane, as in the lobster and the air-breathing insects, but the sac contains a small loose bony or chalky concretion, called an otolithe (οὖς ὠτὸς, the ear, and λίθος, a stone), which answers the same purpose, namely, to indicate the degree and direction of sound; for just as we estimate a weight by poising it in the hand, or, if it be suspended, by gently pushing it from us—thus measuring in our minds the muscular tension necessary to support it, or the force required to overcome its inertia, and conscious of the direction in which we exert our muscles—so, conversely (the weight and inertia of the lapillus always remaining the same), the degree and direction of a vibratory force affecting it from without through the medium of the integuments, the parietes of the vestibule, and the fluids within, may be estimated by a consciousness on the part of the animal of the nature of the stress on the sensitive membranes and fibrils which support it, which by their elasticity restrain and redress the slight movements impressed upon it. This should be borne in mind; for, as we shall see further on, it is in some degree by the exertion of the muscular sense, as Sir Charles Bell has called that by which we judge of weight and tension, that the human ear is enabled to estimate the intensity of sound. Other curious particulars as to the function of otolithes might be enlarged upon; but we have said enough to explain, as we think, the most important of them; and to correct the misstatements of authors who tell us that they are intended to increase the intensity of the vibrations of sound: they appear to us rather calculated to diminish it, as the board floating in the bucket of the water-carrier tends to pevent the fluid from dashing over the side. They undoubtedly play an important part in the organ of hearing, especially in the larger fishes, where they are more numerous, and attain a considerable size; but it is difficult to conceive that they are possessed of any intensative power.

The vertebrated classes of the animal kingdom, comprising the true fishes, reptiles, birds, and the mammals, are all provided with acoustic organs, which are very various in their degrees of complexity, but much exceed in that respect the comparatively simple organs of the inferior divisions.

In the Cartilaginous Fishes, such as the ray and the shark, the vestibule is deeply imbedded in the elastic walls of the back part of the cranium, near its junction with the spine. The fenestra ovalis, closed by a tense transparent membrane, faces upwards, backwards, and towards the middle line. The membrane is placed obliquely at the bottom of a more superficial flattened tubular cavity, which terminates beneath the integument in a kind of forked extremity, and may be considered as a rudiment of the tympanum, or middle ear, of the higher *Vertebrata*, with its Eustachian tube. The inner surface of the membrane is turned towards three sacculi, one of which is much larger than the rest, arranged at the opposite side of the cavity of the vestibule, and containing each an otolithe. The sacs are filled with a thick gelatinous endolymph, which adheres to the lapilli, and serves, with minute filaments, such as those in the *Sepia*, to steady them. The vestibule is filled with a limpid aqueous perilymph, traversed in all directions by a fine cellular network, by means of which its contents are supported in their relative situations. Besides the fenestra ovalis, other perforations lead out of the vestibule into three arched cylindrical canals of considerable diameter and dimensions, the diverging curves of which take a wide circuit within the cranial cartilage, and terminate at both ends in this central cavity. These passages, from their situation and form, are called the anterior, posterior, and horizontal semicircular canals. Within the canals, in which the vestibular perilymph freely circulates, there are three similarly curved but more slender membranous elastic tubes: they are nowhere in contact with the sides of the canals, but are suspended in the midst of them by means of the cellular net-work above mentioned. They all swell out at one end like a flask (ampulla) as they enter the vestibule, after which the anterior and horizontal tubes separately enter a common pouch or sinus; into this their other ends likewise open by a conduit common to both. The posterior tube, which is the largest and longest, after forming its ampulla resumes its former calibre, and passing along the floor of the vestibule under the largest sac, to which it is connected by the network, returns into itself, thus completing a separate circuit.

The fluid contents of the several membranous cavities do not communicate with each other or with the vestibular perilymph; though, as they lie in close apposition, their vibrations are mutually interchangeable.

The acoustic nerve is distributed in two principal branches only to the sacs and the ampullæ; chiefly to the latter, to which it gives a white colour. The filaments form a fine network on the outside of the ampullæ, and then, piercing their parietes, are raised up within into a kind of crescentic screen, in order probably that they may be more exposed to the impulse of the vibrations descending along the aqueous endolymph of the semicircular tubes. All the parts we have described are transparent except the opaque ampullæ and the solid cretaceous otolithes. We have been particular in our account of these membranous parts, which are found with little essential variation in all the superior animals, man included, because in the cartilaginous fishes they admit of more easy examination from their great size and firmer texture, and from the softness of the cartilage that incloses them. In man and the mammals they are not only much smaller and more delicate, but incased in the hardest bone in the body, from which it is almost impossible to separate them with sufficient accuracy to be certain that the description is correct.

In some cartilaginous fishes, as the sturgeon, the fenestra ovalis is not closed by a membrane, but by a round button-like piece of semi-transparent cartilage called an operculum, or lid.

The parts are similar in the osseous fishes, except that they have generally no fenestra ovalis.

In Serpents there is but one sacculus containing chalky matter, and all the semicircular tubes communicate with a central membranous sinus, which the anterior and posterior tubes enter by a common trunk. The fenestra ovalis is closed, not as in fishes by a membrane, but by the expanded trumpet-shaped extremity of a slender bone (ossiculum or columella) attached at the other extremity by a ligament to the outer end of the intermaxillary bone.

Nearly the same arrangement of the internal ear prevails in the Four-Footed Reptiles (turtle, crocodile, frog, lizard); but a new and important step is here made towards the ultimate perfection of the organ by the development of an air-cavity, called the tympanum or ear-drum, between the vestibule and the surface of the head. This addition, which as we said first becomes more than a mere rudiment in the four-footed reptiles, permits the vestibule to be placed with equal advantage at a comparatively greater depth, and therefore in greater security; but it has more important uses in rendering the sound more clear, and facilitating in several ways (to be presently explained) its communication to the auditory nerve. Like the musical instrument from which it takes its name, the tympanum is provided with a membrane tightly stretched upon the margin of a round opening in the outer part of its bony or cartilaginous wall; and has an open vent or passage called after the anatomist who discovered it the Eustachian Tube, leading forwards from the cavity to the throat or back part of the nostrils, by means of which the air within it is adjusted to the variable state of the atmospheric pressure without. If the animal be amphibious, as many of the four-footed reptiles are, the membrana tympani is still covered entirely by integument; sometimes, as in the crocodile, by a moveable flap of the scaly hard skin, which can be raised up when the animal is out of the water. More frequently however the membrane lies entirely beneath the skin, here thinner than elsewhere on the head, as in the tortoise. The *Lacerta agilis*, or Basking Lizard, alone, which lives entirely on the land, has the membrane naked to the air. In this class of animals the columella is not directed forwards to the angle of the jaw as in serpents, but is attached by a cartilaginous extremity to the centre of the membrana tympani, and thus conveys the collected effect of its vibrations directly to the fenestra ovalis: the effect of this arrangement in rendering the impression of sound more definite must be obvious. In some species the cartilaginous portion of the columella is joined to the bony portion at an acute angle, like the letter V, which adds an elasticity to the mechanism very serviceable as a protection to the delicate parts within the fenestra ovalis from the injury they might otherwise sustain by a blow or undue pressure upon the membrana tympani. This is the case with the lizard mentioned above, in which there is also a rudiment of the muscle which serves in the higher animals to tighten the membrane; a circumstance which makes this elbow in the columella a still more essential provision against sudden changes in the distance between the centre of the membrane and the fenestra ovalis. It is worthy of remark that in one class of serpents, the *Cæcilia* (Blind-Worms), the ear is as complete as in any of the four-footed terrestrial reptiles; possessing a tympanum with its membranes, a Eustachian tube, and a columella bent to an angle. This departure from the usual rule in serpents appears to be one of those compensations so frequently met with in the animal kingdom, the organ of sight in the *Cæcilia* being imperfectly developed.

In Birds, besides a greater nicety and tenuity in the conformation of the parts hitherto described, the ear is furnished with two additional provisions, both probably of great consequence to the perfection of the organ. The first is a short meatus auditorius externus, or outer passage, which removes the delicate membrane of the tympanum to some depth from the surface of the head, and thus places it more securely, and at the same time to greater advantage, for observing the direction of sound. The other additional provision in birds is an appendage to the mechanism of the internal ear. This is a small conical cavity in the bone, somewhat curved, with a double spiral ridge winding round the interior, and inclosing a cartilaginous structure so corresponding in form with the ridge as to divide the cavity into two partitions. These communicate with another at the apex, and with the vestibule and tympanum respectively, at their other ends. The cavity is termed the Cochlea, from its resemblance to a spiral shell; the partition communicating with the internal ear is the Scala (winding stair) of the vestibule; the other is the Scala Tympani. The opening from the latter into the tympanum is called the Foramen Rotundum; it is closed by a membrane to exclude the air of that cavity while it permits the transit of vibration to or from the vestibular perilymph within; for that fluid, passing up the cochlea by the scala vestibuli, descends the scala tympani, and bathes the inner surface of the membrane of the fenestra rotunda. The cartilaginous Newel is kept in its place like the semicircular tubes by retiform filaments, and is supplied with a separate branch of the acoustic nerve, which ramifies and expands on its surface. The lapilli, which seem to be chiefly a provision for hearing under water, and are therefore large and solid in aquatic and amphibious animals, appear in birds only as fine crystallised grains of chalk in the utricle or sinus of the vestibule, rendering the endolymph somewhat turbid. The columella is straight, and the membrana tympani pressed outwards by it is consequently convex. There is a crescentic fold of skin extending upwards from the superior margin of the meatus externus, sometimes furnished, as in the horned owl, with a fringe of feathers which can be spread at pleasure like a fan to catch the sound. This fold of skin is a rudiment of the concha, or outer ear, of the *Mammalia*.

As we have already said, it is only in this last-mentioned class of animals that the ear reaches its complete development. It is nearly the same in all of them; the difference being only in the comparative size and shape of the component parts of the organ, and not in their essential structure, number, or arrangement.

We shall therefore describe the organ in one species only.

There is every reason to suppose that in hearing, as in seeing, man has no superiority over many of the lower animals except what arises from that intellectual supremacy which enables him to discriminate and compare his sensations more justly than they can do. Indeed it is certain that in the mere perception of sounds he is inferior to most of the *Mammalia*, and probably to birds; and if the musical faculty should seem to imply a greater perfection of the organ, the error, for such we believe it to be, may perhaps disappear upon reflection. We therefore select the human ear as the type of the organ in *Mammalia*, not because it is in any respect more complete than the rest, but as the most interesting. The same description, of the more important parts at least, might be applied nearly word for word to all.

The parts now to be described fall naturally under a three-fold division into the internal, middle, and external ear.

1. The Internal Ear, comprising the Acoustic Nerve, Vestibule, and Labyrinth, is deeply placed in the interior of the head, within the most compact and hardest of the bones, denominated from that circumstance the petrous or rocky portion of the temporal bone. This wedge-like or triangular projection passes obliquely inward and forward in the direction of the outer tube of the ear, forming a strongly-marked knobby ridge within the cranium, in the basis or floor of that cavity. Near the inner point, which nearly meets its fellow on the other side, and upon its posterior declivity, there is a large trumpet-like hole (meatus auditorius internus) into which the seventh cerebral nerve enters from the medulla oblongata. [BRAIN; NERVE.] The meatus passes in a direction outwards, and therefore obliquely, into the petrous portion for half an inch, and then terminates abruptly in two foveæ, or pits: from the upper of these there goes a winding canal through the substance of the bone, which is the course of the motor nerve of the face (the portio dura of the seventh pair), which, here separating from the auditory nerve, or portio mollis, we need not follow. The latter, splitting into several sets of filaments, finds its way through small sieve-like openings at the bottom of the lower fovea into the internal ear, and is here distributed in three separate portions to the cochlea, the ampullæ of the semicircular tubes, and the utricle or vestibular sac. The cochlea is more complicated than in birds; it consists of a spiral canal in the bone, gradually diminishing as it ascends to a point, wound round a central hollow pillar of bone called the Modiolus, or Newel. From its inner surface, that namely which may be considered as a groove in the modiolus, a thin and spongy lamella of bone projects rather more than half across the canal, ascending in a similar spiral. From the edge of this lamella (called the Lamina Spiralis) a membrane passes to the outer surface of the canal, where it is attached; thus completing the separation of the canal into two scalæ, or winding partitions, which unite at the summit, and open (as before), the lower and narrower into the vestibule, the superior and larger into the tympanum; each scala taking two turns and a half round the modiolus in ascending from the base of the cochlea to the Cupola, or inverted cup-shaped cavity at the summit, placed over the funnel (Infundibulum) into which the top of the modiolus expands. The cochlea is on a level with the vestibule and anterior to it, the base being turned towards the meatus internus; the summit looking outwards and a little downwards, is turned towards the sudden bend of the wide canal in the petrous portion of the temporal bone by which the internal carotid artery enters the cavity of the head. It is the close neighbourhood of this artery as it passes through the compact bone that occasions the rushing sound of the pulse to be heard when the ear is placed upon a pillow, or the attention is led to dwell upon what passes within, by deafness arising from some cause not affecting the parts essential to hearing. The modiolus is hollow to some distance from the base. Up this tubular cavity rises the large cochlear branch of the acoustic nerve, giving off lateral filaments through minute openings arranged spirally, which pass through the light spongy bone, and emerge from different points on the spiral floors and sides of the scalæ, where they ramify in a delicate pulpy expansion upon the membranous tubes which line the spiral osseous canals: the rest of the cochlear nerve passes through capillary perforations in the cul-de-sac of the tubular cavity; and ascending in the substance of the central pillar of the modiolus, is distributed through the bone in a similar way to the upper turns of the cochlea and the infundibulum. The two other branches of the acoustic nerve are distributed to the vestibular sac, which lies in a round depression or pit in the barrel-shaped cavity of the vestibule, and to the ampullæ of the semicircular tubes. The latter all meet in a membranous sinus, or utricle, which occupies another distinct pit of the vestibule, called from its shape the Elliptic Fovea, much according to the arrangement already described in other animals. The principal opening from the vestibule is the fenestra ovalis, situated on the outer side towards the tympanum, which is closed by a membrane. At the lower and front part there is another opening into the scala vestibuli of the cochlea. There are five at its posterior and outer side, which lead into the semicircular canals, of which the superior and posterior enter the vestibule by a common foramen. The sac and utricle each contain a cretaceous deposit called Otoconia, or ear-sand, which in some of the lower *Mammalia* has the consistence of soft chalk. The cochlea and semicircular canals, from their complexity, are termed the Labyrinth. With respect to the object of their peculiar arrangement, not even a probable conjecture has been hazarded. Yet they appear with surprising uniformity in all the *Mammalia*, and some of them, as we have seen, in the more numerous tribes of birds, reptiles, and fishes. The bony canals of the labyrinth and vestibule are stated to be invested within by a delicate periosteum, the surface of which towards the perilymph is thought to be of the nature of a serous membrane, and to secrete that fluid.

Fig. 1.

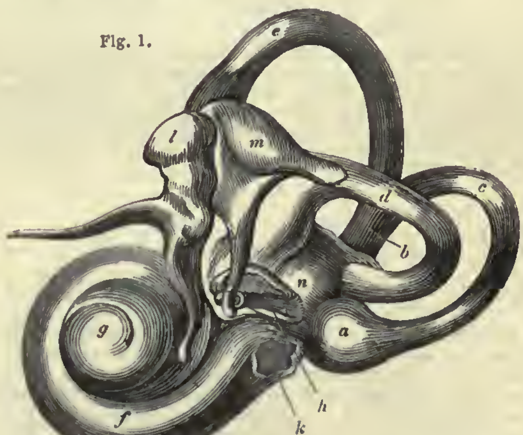


Fig. 1. Magnified view of the osseous labyrinth and vestibule as they would appear if the solid bone in which they are imbedded were removed, with the ossicula auditus in situ: *a*, ampulla of the posterior semicircular canal; *b*, common tube by which this and the superior canal enter the vestibule; *c*, posterior canal; *d*, external canal; *e*, superior canal; *f*, cochlea; *g*, its cupola; *h*, fenestra ovalis covered by the stapes; *k*, fenestra rotunda; *l*, malleus; *m*, incus; *n*, vestibule.

The deafness which arises from causes which affect the fenestra ovalis, or the nerves and canals within the vestibule and labyrinth, is seldom or never cured; and it is unfortunately very common. There is a very easy way by which the nature of the case may be often sufficiently tested. If the internal ear be affected, especially the nerves of it, the ticking of a watch pressed against the teeth or the outer part of the head on that side, will be very obscurely distinguished. If not, the sound can be easily heard, as the solid bones interposed between the sonorous body and the nerve are excellent conductors of vibration.

2. The Middle Ear comprises the cavity of the Tympanum, with its contents; the cells in the bony prominence behind the ear, called the Mastoid Process, with which the tympanum communicates; and the Eustachian Tube, or passage leading from the tympanum into the upper and back part of the throat, where it opens in the form of an expanded slit on each side behind the posterior nares.

The Tympanum is an irregular cavity scooped in the petrous portion of the temporal bone between the vestibule and the external meatus. The principal entrances to it are the fenestra ovalis and the round or somewhat oval opening at the bottom of the external passage upon which the membrana tympana is stretched. Between these there is extended a chain of three small bones, obliquely articulated to each other with perfect joints, so placed that the chain somewhat resembles in figure the letter Z.

These bones are called respectively the Stapes (stirrup), the Incus, (anvil), and Malleus (hammer), from some similarity in form to those implements. The base of the stapes is applied to the fenestra ovalis, exactly fitting it, and is attached firmly to its membrane. The extremity of the longer leg of the incus is articulated to the head of the stapes, and there is a minute bone between them of the size of a small shot, which is generally considered to be only a process of the incus. It is however called from its spherical shape the Os Orbiculare, and is sometimes reckoned as a fourth bone. (*Fig.* 3, o.) The shorter leg of the incus (*fig.* 2, *c*,) rests against the bony parietes of the tympanum at the back part, near the mastoid cells. Upon the hollowed cavity in the head of the incus (*fig.* 2, *a*) the lateral depression of the head of the malleus (*fig.* 2, *k*) is articulated, and moves easily; the long handle of the latter is attached by its extremity (*fig.* 2, *h*) to the middle of the membrana tympani, as well as by a portion of the side of the handle, which lies close to and parallel with the membrane. The long slender process of the malleus called the Processus Gracilis (*fig.* 2, *g*) lies in a slit passing to the articulation of the jaw called the glenoid fissure.

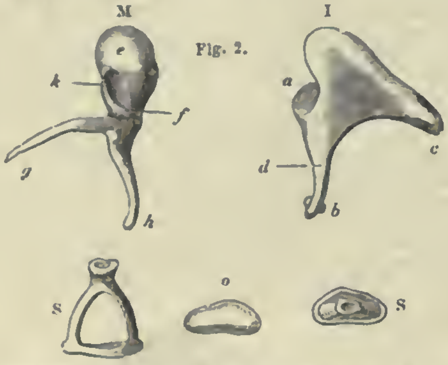


Fig. 2. Magnified view of the ossicula auditus: M, malleus; I, incus; S, stapes; *o*, shape of the fenestra ovalis; *a*, cavity of the incus, which is articulated to the malleus; *d*, longer process of the incus with the os orbiculare attached at *b*; *c*, its shorter process; *e*, head of the malleus; *f*, its short process, or prominent point for the attachment of the tensor tympani; *k*, the depression which articulates with the incus; *g*, processes gracilis of the malleus; *h*, its handle, or manubrium.

Fig. 3.

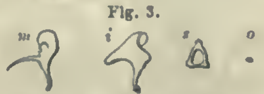


Fig. 3. The same bones of their natural size: *m*, malleus; *i*, incus; *s*, stapes; *o*, orbiculare.

At first sight the use of these bones would appear to be to transmit the vibrations of the membrana tympani to the membrane of the fenestra ovalis, and thence to the internal ear, but when it is found that sounds can be heard with distinctness even when the membrana tympani and the ossicula have been removed by disease, it is evident that this function can be performed independent of them. They have evidently another use which would be incompatible with a single bone passing between those membranes, as in birds and most reptiles; this is to permit the membrana tympani to be drawn into a conical shape so as to tighten it, and adapt it either to resist the impulse of too loud a sound, or favour a more acute or gentle one. The muscle which chiefly effects this object, called the tensor tympani (*fig.* 4, *a*), is attached near the head of the malleus to a point projecting from it. (*Fig.* 2, *f*.) Other muscles, to steady and antagonise its action, called the laxator major and minor tympani are also attached to the malleus, the former (*fig.* 4, *b*) to the processus gracilis, the latter (*fig.* 4, *c*) to the handle of the bone. A further description of the directions and outer attachments of these minute muscles would be tedious and unintelligible to the general reader. No muscle is attached to the incus, but a small one of great importance is inserted into the neck of the stapes, called the stapideus; the effect of this is to counteract the obliquity of traction or tilting of the stapes, which would otherwise ensue from the movements of the other bones; by this means the motion of the stapes is directed either immediately to or from the fenestra ovalis, the membrane of which is also further preserved from injury by the oblique arrangement of the joints of these minute bones, by means of which, although the membrane of the tympanum oscillates through a considerable space in passing from tension to relaxation, that of the fenestra is moved to a much smaller extent. It is to be observed that the same action which draws the membrana tympani into a cone thrusts the base of the stapes farther into the fenestra ovalis.

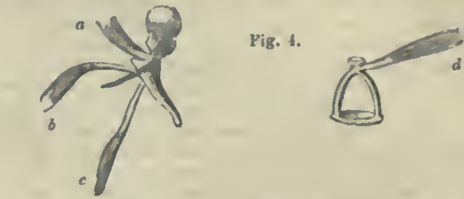


Fig. 4. Muscles attached to the ossicula auditus: *a*, tensor tympani; *b*, laxator major; *c*, laxator minor; *d*, stapideus.

These small muscles are not under the dominion of the will, being supplied with nerves in a way peculiarly interesting to a physiologist, and acting automatically in correspondence with the impressions on the auditory nerve. Yet the instinctive consciousness we have of the degree of their contractions in adjusting the tension of the membrana tympani to circumstances, is probably one of our chief means of estimating the intensity of sounds.

The fenestra ovalis is situated nearly opposite the membrana tympani, on the upper edge of a prominence called the Promontory; it faces outwards and a little downwards; and beneath it, concealed by the promontory, is the foramen rotundum, closed by a membrane, and leading into the cochlea by the scala tympani. The object of this last opening is disputed: some think it conveys in part the vibrations of the air of the tympanum to the internal ear; but it seems more reasonable to suppose, with Sir C. Bell, that the end it chiefly serves is to give vent and freedom to those of the fluids pent up in the unyielding bony canals of the labyrinth. Besides these openings from the tympanum, there are others which lead into the mastoid cells behind it; these are also filled with air, and are supposed to contribute to the distinctness of the tympanic vibrations. There is also an opening from the tympanum forwards into the Eustachian tube. This canal is nearly two inches long; the first part of its course from the tympanum is bony: it then becomes cartilaginous, and widens as it approaches the throat, the mucous membrane of which lines it, and thence passing into the tympanum, spreads over the surface of the whole cavity, investing the ossicula and its other contents, as well as the mastoid cells. From this circumstance arises the tendency of the inflammation of cold or sore throat to extend into the tympanum, producing temporary deafness, ear-ache, and sometimes mischief of a more permanent kind. From the deafness which accompanies the closure of the Eustachian tube by that or other causes, the importance of its functions in renewing and giving vent to the air within the tympanum may be appreciated. Besides the foramina already mentioned, there are others through which nerves and vessels enter the tympanum. We have not space to describe them: we shall only mention that one of the nerves, called the chorda tympani, originally connected with the portio dura of the seventh nerve, after traversing the petrous bone in a circuitous course, enters the cavity of the tympanum, and passing quite across it, is transmitted through the glenoid fissure to a salivary gland under the lower jaw. The object of this singular but uniform course of the chorda tympani is not well understood.

Deafness arising from the closure of the Eustachian tube has been sometimes cured by dilating that canal by instruments passed for that purpose into its outer expanded extremity through the nostrils, or from the back of the throat; or by injecting fluids into it by means of a syringe with a small curved pipe. This latter plan has also been successful in curing deafness arising from chronic inflammation or morbid secretion within the tympanum. Suppuration within that cavity or in the mastoid cells sometimes results from high inflammation, and has been attended with fatal consequences by spreading to the bones of the cranium, or along the nerves to the brain or its membranes. Cases of this kind generally originate, as we have already stated, in cold with sore throat, and are found to occur chiefly in scrofulous habits.

3. The External Ear consists of the Meatus Auditorius Externus (*fig.* 5, *m*), and Concha. The former, commencing from the membrana tympani, is an osseous canal in the first part of its course in the adult, and then becomes nothing more than a tubular continuation of the expanded cartilage of the concha, or outer appendage of the ear. It is lined throughout with a delicate skin, covered by a thin cuticle, which also covers the outer surface of the membrane. Beneath the skin, and opening through it on the surface, are numerous glandular follicles which secrete the ear-wax or cerumen. In the fœtus and new-born infant there is hardly any appearance of this tube; the membrane of the tympanum being close to the surface of the head, stretched upon the inner margin of a bony ring (annulus auditorius)

which afterwards increases in length and becomes a tube. In the adult the length of the whole tubo may be nearly an inch; but from the obliquity of the membrane, which faces a little downwards, it is longer below than above. Its direction from the membrane is outwards and a little backwards, and it is slightly convex upwards, and rather narrower in the middle than elsewhere. The last-mentioned peculiarity is the reason why it is so much easier to introduce beads and other round bodies (as children are apt to do) than to get them out. This however must always be done as soon as possible when such an accident happens; for the presence of the foreign body sometimes excites great inflammation and swelling, and may lead to very

Fig. 5.

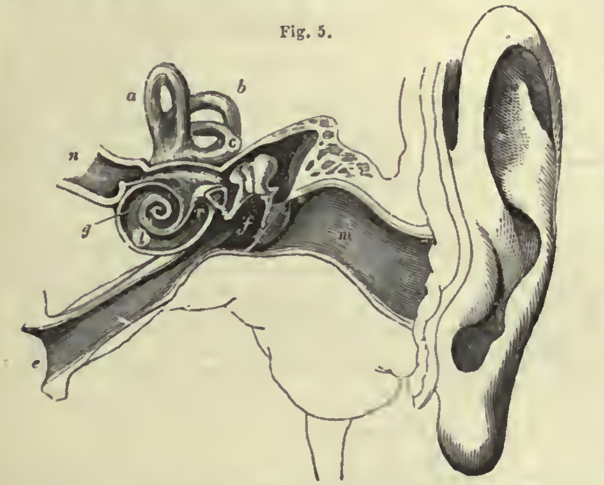


Fig. 5. This is not to be considered as a correct delineation of the organ, being intended only as a diagram, to give a general idea of the relative situations of the several parts: *a*, superior semi-circular canal; *b*, posterior ditto; *c*, external ditto; *d*, scala tympani of the cochlea opened, to show *r*, the fenestra rotunda, entering the tympanum under the promontory; *e*, Eustachian tube; *f*, membrana tympani; *g*, vestibule, not laid open; *m*, meatus auditorius externus; *n*, meatus internus, terminating in two foveæ.

serious consequences. The most easy method and the least painful is to direct a strong stream of warm water into the tube with a syringe, which commonly succeeds immediately if resorted to before there is much swelling. Other means will readily suggest themselves; but if resorted to, they should be very tenderly used, for the part is extremely sensitive, especially the membrane itself, to rough contact. The wax, which is very bitter, serves to prevent the entrance of insects and to keep the skin soft. When secreted too abundantly, it is often a cause of deafness, and should be removed as a foreign body by means of a syringe and a solution of soap in warm water. The commonest kind of ear-ache is that caused by inflammation of this passage, and is generally followed by a copious and fœtid secretion poured out by

Fig. 6.

Fig. 6. View of the pinna, or auricle. The cartilaginous prominences are, *a*, helix; *b*, anti-helix; *d*, tragus; *e*, anti-tragus; the lobe or lobulus, *g*, contains no cartilage, being composed only of skin and a fatty cellular tissue. The depressions are *c*, the scapha or scaphoid (boat-like) fossa; and *f*, the concha, a term often used to denote the whole appendage of which it is the most important part.

the ceruminous follicles. If this last long, deafness is sometimes the result from thickening of the membrane, and has been removed, as well as that arising from closure of the Eustachian tube, by puncturing the membrane. This part is sometimes ruptured by the spasmodic action of the tensor muscle caused by loud sounds, or by driving air up the Eustachian tube in a forcible expiration, as in blowing the nose violently. This accident is not followed by the degree of deafness that might be expected, unless the stapes becomes displaced from the fenestra ovalis: the other ossicula may be lost with comparative impunity for obvious reasons.

The concha, or pinna, or auricle (for by all these names the outer appendage of the ear is known), consists of several pieces of elastic cartilage expanded in a form more or less resembling an ear-trumpet in different animals. In man it serves the purpose of collecting the sonorous vibrations and directing them into the meatus externus much less perfectly than in many other animals, which are also provided with muscles for directing it to the source of sound, which in man are but rudimentary. It is marked with various prominences and hollows, of which the names are given in the figure. It does not seem necessary to describe them more particularly. The cartilages are bound by ligaments to the neighbouring prominences of bone, and are covered by a smooth and closely adherent skin.

It may be observed that the Aquatic *Mammalia* (Whales, Porpoises, &c.) are unprovided with this part of the organ; and have a very narrow but long and curved meatus externus, passing obliquely into the surface of the head, and in some instances capable of being closed by a flap of moveable skin to exclude the water. In these animals also the cochlea is imperfect, the scalæ making but one turn and a half round the modiolus. For an account of diseases of the ear, see DEAFNESS, in ARTS AND SC. DIV.

(Scarpa, *de Auditu*; Blainville, *Comp. Anat.*; Bell, *Anatomy*; Grant, *Outlines*; Pilcher, *On the Structure, &c. of the Ear.*)

EAR-SHELL. [HALIOTIDÆ.]

EARTH-NUT. [BUNIUM.]

EARTH-NUTS are either the fruit of certain plants which bury it below the ground after the flowering is past, as the *Arachis hypogæa*, *Lathyrus amphicarpos*, and others, or else the subterranean tubercles of fleshy-rooted plants, such as *Bulbocastanum*, *Cyclamen*, *Lathyrus tuberosus*, *Apios tuberosa*, and the like.

EARTH-WORM. [ANNELIDA.]

EARWIG. [FORFICULIDÆ.]

EBENA'CEÆ, *Ebenads*, a natural order of Monopetalous Exogenous Plants with the following essential characters:—Flowers either with separate sexes, or occasionally hermaphrodite. Calyx permanent, with from three to six divisions. Corolla monopetalous, regular, of a thick leathery texture, usually downy on the outside, with the same number of divisions as the calyx. Stamens twice or four times as numerous as the lobes of the corolla, adhering to its tube, and usually in two rows; sometimes adhering in pairs. Styles several. Fruit fleshy, superior, with only one pendulous seed in each cell. Embryo lying in much albumen, with large leafy cotyledons and a long taper radicle. The species consist entirely of bushes or trees, some of which are of large size; their leaves are alternate, with no stipules, and generally leathery and shining. They are chiefly Indian and tropical species. A few occur at the Cape of Good Hope and in Australia. This order is related to *Aquifoliaceæ*, *Oleaceæ*, and *Sapotaceæ*. There are 9 genera and 160 species. *Diospyrus Ebenus*, and some others, yield the valuable timber called ebony. The fruit of *D. Kaki* is about as large as an apricot, and is dried as a sweetmeat by the Chinese. Most of the plants of this order are tropical; of the few found beyond the tropics, *D. Lotus* inhabits Africa and Switzerland, and *D. Virginiana* the United States. [DIOSPYRUS.]

A branch of *Diospyrus Lotus* in fruit: 1, a flower; 2, a corolla, cut open; 3, the calyx and ovary; 4, a section of a ripe fruit, showing the seeds.

EBONY. [DIOSPYROS.]

EBURNA. [ENTOMOSTOMATA.]

ECCREMO'CARPUS, a genus of Plants belonging to the natural order *Bignoniaceæ*. *E. scaber* is a climbing plant, inhabiting thickets and hedges in Peru and Chili, and scrambling among the branches of bushes and small trees. It has an angular cinnamon-brown stem, with pale-green succulent branches; opposite pinnated trifoliolate leaves, with obliquely cordate serrated leaflets, and a terminal tendril; horizontal racemes of tubular orange-scarlet obliquely ventricose flowers, the limb of whose corolla is narrow and 5-lobed; and remarkable oval compressed pods covered all over with short tubercles, and opening into two thin convex valves, within which is placed a number of thin winged netted seeds. It is a handsome half-shrubby plant, which will live in the open air in the milder parts of England. By some it is called *Calampelis scabra*.

ECCULIO'MPHALUS, a genus of Fossil *Gasteropoda*, from the Mountain Limestone chiefly. (Portlock.)

ECHENEI'S, a genus of Fishes belonging to the section of Subbrachial *Malacopterygii* and the family *Echeneidæ*. The body is elongated, covered with very small scales; a single dorsal fin placed opposite the anal; the head very flat, covered with an oval disc formed by numerous transverse cartilaginous plates, the edges of which are directed backward; the mouth wide, with numerous small recurved teeth on both jaws, the tongue, and the vomer. (Yarrell.)

The species of this genus are not numerous. Cuvier enumerates four, and another has been described from the West Indies. They are all easily recognised by the peculiar adhesive disc on the top of the head, by means of which they attach themselves to other fishes, the bottoms of vessels, or other objects floating in the sea. The object of this contrivance is not very well ascertained.

E. remora, the Common Remora, or Sucking-Fish, is found in the Mediterranean Sea, and was known to the Greeks and Romans. Dr. Turton once took a specimen of this species riding on a codfish in Swansea Bay. The following is Mr. Yarrell's description of the sucking apparatus:—

"The disc of the adhesive apparatus in the specimen now described, with seventeen transverse laminæ, was one-third of the whole length of the fish, not including the caudal rays; the breadth one inch and one quarter. The margin is free, flexible, and of considerable breadth, to secure perfect contact with the surface to which it is opposed; the parallel laminæ are represented as only slightly elevated: the degree of adhesion is in proportion to the power used to raise the inner surface of the disc in a direction perpendicular to the plane of contact. The figure on the right side represents the inner surface of the posterior half of the disc. The vertical direction of the moveable laminæ is effected by sets of muscles going off obliquely right and left from two elongated bony processes, one on each half of each of these moveable divisions. The contraction of these muscles acting upon these levers, raises the external edges of the parallel divisions, increasing the area of the vacuum; and it will be observed that the points of the moveable transverse divisions to which the muscles are attached, are nearer the middle line than the outer edge, by which the chance of interfering with the perfect continuity of the free margin, and thereby destroying the vacuum, is diminished. All the bony laminæ, the outer edges of which are furnished with rows of minute tooth-like projections, are moved simultaneously, like the thin vertical divisions of our common window-blinds, by means of the mechanical contrivance on the framework. The longer muscles placed nearer the outer oval edge are probably instrumental in preserving the contact of the more flexible margin, and the serrated external edges of the parallel laminæ help to preserve the degree of elevation obtained: the adhesive power as before observed, is in proportion to the area of the vacuum."

ECHEVERIA, a genus of Plants named after M. Echeveri, author of the drawings in the 'Flora Mexicana.' It belongs to the order *Crassulaceæ*. It has a 5-parted calyx, the sepals erect, united at the base. Petals united at the base, erect, thick, stiffish, thickest at the middle nerve, and nearly trigonal at the base, acute. Stamens 10, shorter than the petals, and adnate to them at the base. Scales 5, short, obtuse. Carpels 5, ending each in a subulate style. The species are succulent shrubs, natives of Mexico. None of the species are used in the arts or medicine, but their handsome leaves and showy flowers give them a place in every collection of plants. The genus is closely allied to *Sedum*, and many of the species resemble that genus.

ECHIDNA (Cuvier), *Tachyglossus* (Illiger), a genus of Monotremes, *Monotremata* (Geoffroy), the third tribe of the order *Edentata* (Cuvier's sixth order of Mammifers) none of which have any incisor teeth in either jaw.

Dental formula 0.

The following are the characters of this genus:—Muzzle elongated, slender, terminated by a small mouth furnished with an extensible tongue, similar to that of the ant-eaters and pangolins. No teeth, but the palate armed with many rows of small spines directed backwards. Feet short, very robust, and formed for digging, each armed with five long claws. Tail very short. Body covered with spines like that of the hedge-hog. Stomach ample and nearly globular; cæcum moderate. Leur verge se termine par quatre tubercules.

Of this curious genus, zoologists are agreed that only one species has been yet discovered, though two have been recorded, namely, *Echidna Hystrix* and *Echidna setosa*, the so-called two species being the same animal in the clothing of different seasons, or of different periods of age. This species is the *Myrmecophaga aculeata* and Porcupine Ant-Eater of Shaw, *Ornithorhynchus aculeatus* of Home, *Echidna Hystrix* and *Echidna setosa* of G. Cuvier, *Echidna Australiensis* of Lesson, Hedge-Hog of the colonists at Sydney.

Skull of *Echidna*.

The size is about that of the common hedge-hog. The spines are dirty-white for the greatest part of their length, and black at their extremity. Hair of a chestnut colour, soft and silky, in such abundance, at a certain season, as to half cover the spines, whilst, at another, the hair entirely disappears.

This animal lives on ants, which it captures with its extensile tongue.

The habits of the *Echidna* in a state of nature are but little known. It digs for itself burrows, wherein it remains during the dry season, coming out of the earth only during the rains. It is supposed to be capable of supporting a long abstinence, and has intervals of suspended animation (engourdissemens), which continue for eighty hours at a time, and recur frequently when the animal is kept in confinement. For protection the animal is said to be able to roll itself up like a common hedge-hog.

Porcupine Ant-Eater (*Echidna Hystrix*).

Lieut. Breton had an *Echidna* which lived with him for some time in Australia, and survived a part of the voyage to England. The animal was captured by him on the Blue Mountains: it is now very uncommon in the colony of New South Wales. It burrows readily, but he does not know to what depth. Its strength he considers as exceeding, in proportion to its size, that of any other quadruped in existence.

Previous to embarkation, Lieutenant Breton fed his *Echidna* on ant eggs (pupæ) and milk, and when on board its diet consisted of egg chopped small, with liver and meat. It drank much water. Its mode of eating was very curious, the tongue being used sometimes in the manner of that of the chameleon, and at others in that in which a mower uses his scythe, the tongue being curved laterally, and the food, as it were, swept into the mouth: there seemed to be an adhesive substance on the tongue, by which the food was drawn in. The animal died suddenly off Cape Horn, while the vessel was amidst the ice; perhaps in consequence of the cold, but not improbably on account of the eggs with which it was fed being extremely bad.

Lieutenant Breton concurs with Messieurs Quoy and Gaimard in thinking that there would be little difficulty in bringing the *Echidna* to Europe, and the following plan is suggested by him for effecting its importation:—

Previously to embarkation the animal should be gradually weaned from its natural food (ants). This may be done by giving it occasionally ants and ant-eggs, but more generally milk, with eggs chopped very small, or egg alone. It should be kept on shipboard in a deep box, with strong bars over the top, and a door. The box or cage must be deep, because the animal constantly tries its utmost to escape; and, as it possesses very great strength, it is liable to injure itself in its exertions to force its way through the bars. Its excrements are so extremely fetid, that it cannot be kept altogether in a cabin, unless the cage be frequently cleaned. While this is being done, the *Echidna* may be allowed its liberty, but must be narrowly watched, or it will certainly go overboard. It is absolutely necessary that the eggs on which it is fed during the voyage should be as fresh as possible: they can be preserved in lime-water. If milk is not to be procured, water must be supplied daily; and egg and liver, or fresh meat, cut small, should be given at least every alternate day. When the weather will permit, it should be fed once a day. Half an egg, boiled hard, and the liver of a fowl or other bird, will suffice for a meal. The animal should be kept warm, and should be well supplied with clean straw. It will be as well to nail two or three pieces of wood (battens) across the floor of the cage, to prevent the animal from slipping about when the ship is unsteady. ('Zool. Proc.,' 1834, Part 2.)

It inhabits the Blue Mountains, &c., the environs of Port Jackson, and Van Diemen's Land.

ECHINARACHARIAS. [ECHINIDÆ.]

ECHINASTRÆA. [MNADREPHYLLIŒA.]

ECHI'NIDÆ, a family of Radiated Animals, comprehending those marine animals popularly known by the name of Sea-Eggs, or Sea-Urchins (Oursins of the French).

De Blainville makes the *Echinidea*, the second order of the class *Echinodermata*, and he thus defines the order:—

Body oval or circular, regular, sustained by a solid shell, which is calcareous and composed of polygonal plates, disposed in radiated order in 20 rows, which are either equal, or alternately and regularly unequal. The shell supports upon proportionable mamillary projections stiff spines which are extremely variable in form, and is pierced by a series of pores, forming by their assemblage a kind of ambulacra. It radiates more or less regularly from the summit to the base, and gives exit to tentaculiform cirrhi. Mouth armed or unarmed, pierced in a notch of the shell invariably on the lower side. Vent always distinct, but offering many variations in its position. Generative orifices four or five in number, disposed round the dorsal summit.

The Sea-Urchins are a family of considerable interest both to the zoologist and geologist. To the first they offer the most perfect examples of the type of radiate animals, whilst their hard covering and habits of living in the sand, have preserved them in many rocks of the strata of the earth for the study of the geologist. They are distinguished from the other *Echinodermata* by their form, which is more or less rounded without arms of any kind. Calcareous matter is deposited within their integument so as to form a series of regular plates, which are studded with tubercles, bearing jointed on them spines of various forms and sizes according to the genus or family. These spines are sometimes small in proportion to the size of the body, but in others they are singularly large, and excite wonder as to how they can be employed by the animal. These spines have a beautiful microscopic structure, being composed of cells which are arranged around a common centre, almost in the same manner as the zones of wood in a tree. (Carpenter 'On the Structure of Shells.') As in other *Echinodermata*, the Sea-Eggs have ambulacra variously arranged, perforated with pores for the exsertion of suckers, or feet. The ovarian holes are seated on the apex, whence the eggs are extruded. There are two openings for the digestive apparatus—a mouth, always placed below and sometimes connected with an internal dental apparatus, and a vent, which is very variable in its position. The intestine is winding, and is attached to the inner surface of the shell by a mesentery, the surface of which, as well as of the membrane, lining the shell, is covered with vibratile cilia, and undoubtedly serves for respiratory purposes. The ovaries are placed in the spaces between the ambulacra. The vascular system is more or less complicated, having a portion with muscular parietes, and exhibiting pulsations. Van Beneden has asserted the existence of a nervous system in the *Echinidæ*, but no one has yet confirmed his observation.

The Sea-Urchins progress by means of the joint action of their suckers and spines. Many of them moor themselves also by means of suckers, and thus adhere firmly to the rocks. Professor Agassiz denies that they adhere by means of their suckers, or that these organs serve the purposes of progression. This is however opposed to the observations of the majority of naturalists, and Professor E. Forbes refers especially to this point for the purpose of giving his unqualified opposition to the assertion of Professor Agassiz. As to what uses these organs are applied to, if not for progression, Professor Agassiz states that "we are yet unable to solve."

The Sea-Urchins are free throughout their existence, unlike the *Asteriadæ*, in which we find a fixed condition in the earliest periods of their development. [ECHINODERMATA.]

With regard to the classification of the *Echinidæ*, Professor E. Forbes remarks that there has been "a tendency to an extreme multiplication of genera."

Breyn, Klein, Linnæus, Leske, Lamarck, Cuvier, Gray, Desmarest, Goldfuss, Von Buch, Desmoulins, Agassiz, and E. Forbes, are the principal zoologists who have undertaken the classification of the *Echinidæ*. De Blainville observes that the relative position of the mouth and the vent, and above all, of the ambulacra, are the principal points on which most of these writers have rested; and as he considers that this mode of viewing the subject has led to approximations not very natural, he proposes a system based on the following grounds:—

1st. On the general form of the body of the animal, which, at first subradiated, becomes by little and little completely radiated in all the parts which constitute it.

2nd. Upon the position of the mouth, which, nearly terminal and transverse, or bilabiated, in the first species, becomes completely central and circular in the last.

3rd. On the arming of this mouth, which, completely null in a great proportion of the *Echinidæ*, is, on the contrary, very powerful in the rest.

4th. Finally, on the position of the vent, on the number of ovaries and their orifices, on the nature of the spines and the tubercles which support them, as well as on the disposition of the ambulacra.

Synoptical Table of the Genera, according to De Blainville:—

Mouth	Subterminal		*Spatangus.* *Ananchites.*
	Subcentral	Without teeth	*Nucleolites.* *Echinoclypeus.* *Echinolampas.* *Cassidula.* *Fibularia.* *Echinoneus.*
		Armed with teeth	*Echinocyamus* *Laganus.* *Clypeaster.* *Echinodiscus.* *Scutella.*
	Central; Vent	Infra-lateral	*Galerites.*
		Central	*Echinometra.* *Echinus.* *Cidaris.*

Sub-Family 1. *Excentrostomata.*

Spatangus.—Body oval, more or less elongated, heart-shaped, wider before than behind, with a furrow more or less profound at the anterior extremity. Shell delicate, of little solidity, composed of large polygonal plates, not many in number. Spines short, flat, sessile, and scattered. Ambulacra incomplete, only four in number. Buccal notch more or less anterior, transverse, bilabiated, circumscribing a mouth without teeth. Vent terminal, and rather above than below the border. Genital pores four in number, disposed in two pairs. The species are very numerous, and are subdivided by De Blainville and others into sections according to their shape, &c. The following is De Blainville's method:—

a. Species whose ambulacra are not petaloid, and form scarcely but two lines, a little broken or bent at their internal side, and which have a rather deep anterior furrow, and the mouth not much in front.

S. arcuarius of Lamarck, the Common Heart-Urchin, may be taken as an example of this section. It is the *S. pusillus* of Leske; *S. cordatus*, Fleming; *S. flavescens*, Müller; *Echinus spatangus*, Linnæus; *E. pusillus*, Gmelin; *E. cordatus*, Pennant; *Amphidotus pusillus*, Agassiz. It is the commonest form of *Spatangus* in the European seas. It abounds in all the bays of Great Britain, and after storms is cast on shore. Popularly it is called in England the Mermaid's-Head, the Child's-Head Urchin, the Hairy Sea-Egg.

β. Heart-shaped species, with five deep and straight dorsal furrows, in which the ambulacra are hidden. Ex. *S. Atropos.*

γ. Species whose ambulacra are petaloid, going from a centre, and which have an antero-dorsal furrow more or less deep, occupying the place of the fifth ambulacrum; the posterior pair shorter than the anterior. This section is divided into sub-sections, according to the depth of the ambulacra.

S. purpureus, the Purple Heart-Urchin, is an example of this section. It is found in the seas of Great Britain, and is one of the handsomest species of the whole family. It grows to the length of 4 inches by 3¼ inches broad. It is of a deep purple colour, with pale spines; some of the spines are very long and curved.

δ. Species whose anterior furrow is much less deep, or nearly null, and whose ambulacra, more or less petaloid, to the number of four, occupy the greatest part of a sort of dorsal plate, circumscribed by a sinuous line without tubercles or spines. This section includes the genus *Brissus* of Klein.

B. lyrifer (Forbes), the Fiddle Heart-Urchin, is a British species, and may be taken as an example of the section. This species has been taken by Professor E. Forbes in various localities in the æstuary of the Clyde, off the island of Cumbury in Rothsay Bay and the Kyles of Bute. It is a handsome and remarkable species. It has a red body with pale yellowish-white spines, and the dorsal and post-anal impressions of a rich brownish-purple. It inhabits mud at the depth of from 10 to 15 fathoms.

ε. Heart-shaped species, rather strongly widened and notched in front, with five distinct and truncated ambulacra. Ex. *S. gibbus.*

ζ. Species whose anterior furrow is still distinct; whose ambulacra, to the number of four, are marginal, and sometimes complete, or reaching up to the mouth; and whose genital pores are five. This section is subdivided into two, according to the extent of the ambulacra, the first (ex. *S. subglobosus*), with ambulacra only reaching the circumference; the second (ex. *S. cordatus, Ananchites cordatus*, Lam.), with ambulacra reaching to the border.

De Blainville supposes that the *Spatangi* are nourished with the animal matters which are mingled with the sand; for their intestinal canal, which is thin as a spider's web, was always found by him full of fine sand.

Ananchites (fossil only).—Body oval in its longer diameter (from before backwards), rounded and a little wider, but without a furrow, anteriorly, subcarinated posteriorly, conical, elevated at its summit, which is mesial, entirely flat below, covered with a very few small scattered tubercles. Ambulacra, to the number of five, rather large, divergent, comprised between double lines of pores but little approximated, and scarcely overpassing the borders. Mouth and vent subterminal and inferior. De Blainville subdivides this genus into two sections; the first, with the ambulacra prolonged up to the borders (*Ananchites*. Lam.), ex. *A. ovatus;* the second, with the ambulacra prolonged up to the mouth (*Echinocorys*, Leske, Gray; *Galea, Galeola*, Klein), ex. *A. pustulosus, Echinocorytes pustulosus*, Leske.

Sub-Family 2.—*Paracentrostomata Edentata.*

Nucleolites (fossil only).—*Echinobrissus* of Breyn and Gray, adding the *Cassidulæ.*—Body oval or heart-shaped, wider and with a large furrow behind, rather convex, the summit sub-central and moderately elevated above, somewhat concave below; covered with small equal and scattered tubercles. Ambulacra, to the number of five, subpetaloid, open at the extremity, dorsal and marginal, and continued by as many furrows up to the mouth, which is inferior, subcentral, and anterior. Vent sub-central, above, in the furrow. Genital pores to the number of four. Ex. *N. depressus, Spatangus depressus*, Leske, Klein; *Clypeus lobatus*, Fleming.

The species are tolerably numerous and are frequent in the Chalk, but are also found in the beds anterior and posterior to it.

Echinoclypeus (fossil only).—Body depressed or conical, circular or inclining to oval, with a furrow behind, convex and with a sub-central summit above, rather excavated below, formed of distinct plates and covered with very small equal tubercles. Ambulacra to the number of five, dorso-marginal, sub-petaloid; the double rows of pores united by a transverse furrow. Mouth sub-central, a little more anterior, pentagonal, with five converging ambulacriform furrows. Vent entirely above, behind the summit, and at the origin of the posterior furrow. Genital pores to the number of four.

Echinolampas, Gray. (*Echinanthus?* Leske).—Body oval or circular, depressed, sub-convex above, rather concave below, rounded and widened forward, rather narrowed towards the anal extremity, composed of great polygonal plates and covered with spines, probably very small. Ambulacra, to the number of five, sub-petaliform, not closed at their extremity, and nearly approaching the border. Mouth round, sub-central, and nevertheless a little anterior. Vent entirely marginal, terminal. Genital pores four only in number. Ex. *E. orientalis* (recent).

Cassidula. — Body oval, more or less depressed, composed of indistinct plates and covered with small spines. Ambulacra five, dorsal, rarely marginal. Mouth below, submedian, in a stelliform notch. Vent postero-dorsal, or above the border. Genital pores four.

De Blainville subdivides this genus into the following sections:—

α. Species whose ambulacra form a dorsal star, and whose mouth is at the bottom of a stelliform impression. Ex. *C. Lapis Cancri.*

β, Species whose ambulacra are prolonged to the border and not closed. Ex. *C. Australis.*

γ. Species whose ambulacra are not known to De Blainville. Ex. *C. scutella.*

De Blainville observes that this genus (Lamarck's) is evidently artificial. Goldfuss unites the genus with *Nucleolites.*

Fibularia.—Body globular, but rather higher than it is wide, ribbed, as it were, with about 20 ribs, formed probably by so many ranks of polygonal scales, and covered with very fine spines. Ambulacra five, very short, and not shut at the extremity. Mouth round, sub-central. Vent inferior, and much approximated to the mouth. Genital pores unknown. Ex. *F. craniolaris.*

This genus was established by Van Phelsum and by Leske, under the denomination of *Echinocyamus*, adopted by Dr. Gray. *E. pusillus* is a British species, and Professor E. Forbes says it is one of the connecting links between the true *Echini* and the *Spatangaceæ*. It has the teeth of the former and the spines of the latter. It is the least of all the British species, and one of the smallest of the family. Mr. Forbes says, "I believe the *Fibularia ovulum* and *F. tarentina* of Lamarck, and the *F. angulosa* of Deslongchamps, will all prove to be identical with this species."

Echinoneus.—Body rounded or oval, generally excavated below, composed of plates often distinct and covered with small spines. Ambulacra five, large, complete, radiating from the dorsal centre to the mouth, and formed by ambulacral lines, which are very close and impressed. Mouth central or sub-central, without teeth, and pierced in a sub-triangular hole of the shell. Vent towards the border below or even above, in a longitudinal and sub-symmetrical hole of the shell. Genital pores four.

De Blainville subdivides the genus into the following sections:—

α. Oval species, with the anal hole longitudinal and below. Ex. *E. minor.*

β. Circular species, with the vent below and round. (*Discoidea*, Gray). Ex. *E. subuculus.*

γ. Oval species, with the vent entirely marginal, and the genital pores to the number of seven (?) Ex. *E. ovalis.*

δ. Circular species, which are depressed and have a margino-dorsal, non-symmetrical anal opening. Ex. *E. cassidularis.*

Sub-Family 3.—*Paracentrostomata Dentata.*

Mouth subcentral, in a regular notch of the shell, and provided with teeth.

Echinocyamus.—Body depressed, oval, wider behind than before, a little excavated below, covered with rounded tubercles pierced at the summit and rather large in proportion, supported internally by five double inferior ribs, terminating round the buccal notch by as many simple apophyses. Ambulacra dorsal, not marginal, completely open at the extremity, a little enlarged, and forming a sort of cross with dilated branches. Buccal opening sub-central, regular, armed with five teeth as in *Clypeaster.* Vent below, between the mouth and the border. Genital pores four. Ex. *E. minutus.*

De Blainville states that he characterised this genus from a considerable number of individuals of a very small species found in the intestines of a turbot, and which occurs in great quantity in the sand of the coasts of the English Channel, according to Pallas, both on the French and English shores. He adds that, very probably, it is the *Fibularia ovulum* of Lamarck; and that, without doubt, *Fibularia tarentina* belongs to this genus, as well as *Echinoneus placenta* of Goldfuss.

Lagana, Gray (*Echinodiscus*, Van Phelsum, Leske).—Body depressed, circular or oval lengthwise, a little convex above, concave below, with an entire disc and borders, composed of plates, but little distinct and covered with scattered spines. Ambulacra five, regular, petaloid, shut, or nearly so at the extremity, with the pores of each side united by a furrow. Mouth median in the middle of a hole, with converging furrows and furnished with teeth. Vent inferior, pierced in a regular hole, situated between the mouth and the border. Genital pores five. The genus is thus subdivided by De Blainville:—

α. Circular species. Ex. *L. orbicularis.*

β. Oval species. Ex. *L. ovalis.*

γ. Polygonal species. Ex. *L. decagona.*

The genus approximates to *Clypeaster*, under which Lamarck arranges the species.

Clypeaster.—Body much depressed, rounded and rather thick on the borders, sometimes incompletely orbicular or radiated, enlarged towards the anal extremity, composed of large and unequal plates, covered with very small, equal, scattered spines supported on very small tubercles pierced with a pore. Ambulacra constantly five in number, dorsal, petaloid, the two rows of pores of each branch united by a furrow. Mouth central or sub-central, at the bottom of a sort of tunnel, formed by five grooves and armed with five teeth. Vent terminal and marginal. Genital pores to the number of five.

The living species are but few. They inhabit the seas of warm countries—in Asia and America. Ex. *C. rosaceus.*

The fossil species are more numerous and are generally from the Tertiary Beds.

Echinodiscus.—Body rounded, depressed, sub-quinquelobated (the posterior lobe a little notched in the median line), rather conical above, concave below, composed of plates in 20 rows, placed two and two. The ambulacraires narrower and covered with very small, fine, close-set spines. Ambulacra to the number of five, diverging by the complete separation of each double line of pores. Mouth median, round, towards which converge five straight and stelliform furrows. Vent marginal. Genital pores to the number of four. Ex. *Echinus Parma.*

Echinorachnius placenta, Gmelin, the Cake-Urchin of Forbes, is the *Echinodiscus placenta* of Blainville, *Scutella placenta* of Lamarck. It is described by Forbes as a British species. It has however been seldom taken on our coasts.

Scutella (*Mellita*, Klein; *Echinodiscus*, Leske).—Body irregularly circular, wider behind, extremely depressed, borders nearly sharp-edged, sub-convex above, a little concave below, composed of large polygonal scales, and covered with very small uniform and scattered spines. Ambulacra 5, more or less petaliform, the two rows of pores of each branch united by transverse furrows, which makes them appear striated. Mouth median, round, furnished with teeth, and towards which converge five vasculiform furrows more or less ramified, and sometimes bifid from the base. Vent always inferior and at some distance from the border. Genital pores 4.

The recent species of *Scutella* are arranged as follows:—

α. Species whose disc alone is perforated. Ex. *S. hexapora.*

β. Species whose disc and borders are perforated. Ex. *S. tetrapora.*

γ. Species whose border only is notched. Ex. *S. aurita.*

δ. Species whose disc and border are entire. Ex. *S. integra.*

ε. Species whose disc is perforated and their border multidigitated. Ex. *S. octodactyla.*

ζ. Species whose disc is imperforate and the border multiradiated (Demi-Soleils.) Ex. *S. dentata.*

The living species whose habitat is known are foreign, and the South Seas appear to be their principal locality.

The fossil species are tolerably numerous, and occur generally in the Calcaire Grossier of Paris, Grignon, and the environs of Nice.

Sub-Family 4. *Centrostomata.*

Mouth quite central. Summit median. Body regularly oval or circular, covered with tubercles and mamillæ, and consequently with spines of two sorts. Vent variable, ordinarily medio-dorsal.

Galerites (fossil only); *Conulus*, Klein; *Echinoconus*, De Blainville.—Body nearly regularly circular or polygonal, entirely flat below, convex and often conical, with the summit median above, formed of very dissimilar plates, and covered with tubercles of two kinds. Ambulacra complete, narrow, to the number of 4 or 5, dorso-buccal. Mouth central, and probably armed. Vent infero-marginal. Genital pores to the number of 5. The species may be placed in two sections.

α. Species with 4 ambulacra, and consequently with 6 series of plates. Ex. *G. quadrifasciatus.*

β. Species with 5 ambulacra. Ex. *G. vulgaris.*

γ. Species with 6 ambulacra. Ex. *G. sexfasciatus.*

The genus is often found silicified and in casts. The greater portion belong to the Chalk, and a small number to the beds anterior to the Chalk. None have as yet been found iu the more recent strata.

Echinometra (Gray).—Body thick, solid, transversely oval, a little depressed, convex, with the summit (which is median) flat above and arched below, covered with mamillated tubercles of two sorts, and bearing diversiform but always strong and large spines. Ambulacra 5, enlarging themselves below. Buccal opening of the shell large, transverse, with very powerful auricles on its internal circumference. Five sharp teeth at the mouth, with a complicated apparatus, as in *Echinus.* Vent medio-superal, or opposed to the mouth. Genital pores to the number of 5. Ex. *E. atrata.*

The species are found in tho seas of warm climates. They are unknown in those of England and France.

Echinus.—Body in general very regularly circular or sub-polygonal, sometimes slightly transverse, composed of 20 radiated rows, alternately unequal, of polygonal plates bristled with diversiform spines of two kinds, and supported on imperforate mamillated tubercles. Ambulacra constantly to the number of 5, and complete. Mouth central, armed with 5 pointed teeth, supported upon a very complicated internal apparatus. Vent median, superior, or exactly opposite to the mouth. Genital pores to the number of 5.

The food of the species of *Echinus* is generally believed to consist of mollusks and crustaceans. Tiedemann found in *E. saxatilis* small univalve and bivalve shells entire among the excrements, as well as fragments of larger ones. Boso is said to have witnessed an *Echinus* in the act of seizing and devouring a small crustacean. Dr. Sharpey usually found in the intestine of *E. esculentus* small morsels of seaweed for the most part encrusted with *Flustra;* and he says that the excrements, which are in the form of small round pellets about the size of peppercorns, consist chiefly of sandy matter with fragments of shells. But he adds that it would be difficult to say whether these are the remains of digested *Mollusca* or merely a portion of the usual testaceous debris so abundant in sand and mud.

The species of this genus are most abundant in all the seas of Enrope. Several very fine species are natives of the Mediterranean. The following are British species:—

E. sphæra, the Common Egg-Urchin, Sea-Egg, 'Sca'ad Manshead.' It is the *E. marinus* of Lister; *E. esculentus*, Pennant; *E. globiformis*, Lamarck. It has the following characters:—Rows of pores obliquely parallel, three pairs of pores in each row; spines thick, conic, longitudinally striate; striæ broader than the ridges, and transversely striated; primaries scarcely longer than secondaries. (Forbes.) The Common Sea-Urchin is usually of a reddish or purplish colour with white spines. These are in some specimens tipped with purple. It lives in various depths of water, extending its range from the littoral zone to that of the corallines. It is found in greatest numbers on a clean sea-bottom, but inhabits all the shores of Great Britain and Ireland. It is eaten abroad in the same manner as *Echinus esculentus.* Pennant says it is also eaten amongst the poor in England. The ancients deemed it a dainty dish, and ate it both raw and cooked in various ways. They are best when full of eggs, which is in the autumn.

E. miliaris (Leske), the Purple-Tipped Egg-Urchin, has the following characters:—It is depressed, the rows of pores not parallel, three pairs of pores in each row; spines longitudinally striated, shining, smooth; striæ narrower than ridges; primaries long. (Forbes.) This is a small species, and is found in company with tho last, from which it may at once be distinguished by its long purple spines. It is abundant in the Irish Sea, as also on the west coast of Scotland.

E. Flemingii, Fleming's Egg-Urchin. It is the *E. miliaris* of Fleming, but is undoubtedly a distinct species. It is the largest of the British species, measuring from 10 to 14 inches in circumference. It has the following characters:—Rows of pores sub-parallel, three pairs in each row; primary spines thick, much fewer than the secondary, and nearly thrice as long; spines longitudinally striate; striæ somewhat narrower than tho very narrow ridges. (Forbes.)

E. lividus (Lamarck), Purple Egg-Urchin. It is the *E. saxatilis* of Linnæus; *E. lithophagus* of Leach. It has the rows of pores bent, five pair in each row above and centrally, but diminishing in number near the mouth; spines striated; ridges broad, smooth; primary spines longer than secondaries. (Forbes.) In the British Isles this species is peculiar to Ireland, where it is chiefly found in the south. It is always stationary, never quitting the cup-like hole which it appears to form with its spines.

E neglectus (Lamarck), Silky-Spined Egg-Urchin; *E. subangularis*, Fleming. Rows of pores bent, five pairs in each row throughout; spines thick, conic, glistening, longitudinally striate; striæ and ridges equal, transversely striated; primary spines scarcely longer than secondaries. This species has been taken on the coasts of Scotland.

All the species of *Echinus* present upon their integument a number of bodies called *Pedicellariæ.* Whether they are parts of the animal or parasitic animals has not been decided by naturalists. They are however curiously characteristic of many forms of *Echinus* as of other species of *Echinodermata.* [PEDICELLARIA.]

For further remarks ou the *Echinidæ*, and their fossil forms, in connection with the other species of Star-Fishes, see ECHINODERMATA.

ECHINOBRISSUS. [ECHINIDÆ.]

ECHINOCACTUS, a genus of Plants belonging to the natural order *Cactaceæ.* The stem is of an ovate or spheroidal form, the sides being divided into many ribs, upou whose projecting angles are stationed at short intervals little spiny stars, which are the rudiments of leaves, and from whose centre the flowers appear. The latter consist of numerous sepals collected into a tube, an equally large number of petals, numerous stameus, and a filiform style divided into many lobes at the point. The species are very remarkable for the singular forms of their stems, and for the curious manner in which their spines are arranged. They are often moreover conspicuous for the beauty of their large flowers. The genus is extremely near *Cereus*, from which, according to De Candolle, it only differs in having the sepals and petals distinct from each other, not united into a tube. But as *C. triangularis* has its sepals distinct, and all the *Echinocacti* have more or less of a tube, we consider it better to limit the latter to such species as have a depressed or spheroidal form. With such a limitation the *Cereus Eyresii*, one of the most beautiful of plants, will really beloug to the genus *Echinocactus*, of which it has all the habit; otherwise it would be a *Cereus*, to which its stems bear but little resemblance. There are above 30 species enumerated. Most of them are natives of Mexico and the West Indies. A few are found in Brazil. They are known by the name of Hedgehog Thistles.

Echinocactus Eyresii.

ECHINO'CHLOA (from ἐχῖνος, a hedgehog, and χλόη, grass), a genus of Grasses belonging to the tribe *Paniceæ.* It has compound spikes secund in the whole and in each part; spikelets on one side of a flattened rachis, 2-flowered, the inferior flower rudimeutary; 2 glumes, the lower small, 3-nerved, the upper as long as the flower, 5-nerved mucrouate; the outer palea of the sterile flower resembling and equalling tho upper glume. This is a genus of coarse grasses, of which only one species, the *E. Crus-Galli*, grows in Great Britain. It is a strong coarse grass, bearing any climate better than most others, and is found in the vicinity of London. (Babington, *Manual.*)

ECHINOCIDARIS. [ECHINIDÆ.]

ECHINOCLYPEUS. [ECHINIDÆ.]

ECHINOCOCCUS. [ENTOZOA.]

ECHINOCONUS. [ECHINIDÆ.]

ECHINOCORYS. [ECHINIDÆ.]

ECHINOCYAMUS. [ECHINIDÆ.]

ECHINODE'RMATA. Lamarck made his Radiaires Echinodermes consist of three sections:—1st, the Stellirideans (Star-Fishes), including *Comatula*, *Euryale*, *Ophiura*, and *Asterias*; 2nd, the *Echinidæ*; and 3rd, the *Fistulidæ*, comprehending *Actinia*, *Holothuria*, *Fistularia*, *Priapulus*, and *Sipunculus*.

Cuvier's Echinodermes form his first class of Zoophytes, and this class is divided into two orders:—1st, the Pedicillated Echinoderms, containing the great genus *Asterias* and its sub-genera the *Encrinites*, the *Echinidæ*, and *Holothuria*; and 2nd, the Footless Echinoderms, consisting of *Molpadia*, *Minyas*, *Priapulus*, the Lithoderms, *Sipunculus*, *Bonellia*, and *Thalassema*, with its sub-genera *Echiurus* and *Sternaspis*.

De Blanville's *Echinodermata* are placed as his first class of *Actinozoa*, and are divided into three orders:—1st *Holothuriadea* [HOLOTHURIADÆ]; 2nd, *Echinidea* [ECHINIDÆ]; 3rd, *Stelleridea* [ASTERIADÆ]; embracing the *Encrinites* [ENCRINITES]; as well as the Free Star-Fishes, &c.

The *Echinodermata* belong to the Cycloneurose sub-kingdom.

They are characterised by possessing a well-organised skin, under which or attached to it are frequently found plates of solid matter, constituting a kind of skeleton. They have a digestive and a vascular system, and a circular nervous system has been detected in many of the species. A muscular system is constantly present.

Before speaking of the classification of the *Echinodermata*, we shall refer generally to their organisation and structure.

The nutritive apparatus of the *Echinodermata* is very simple; presenting in most of the family a single orifice destitute of teeth in the centre of the lower surface of the body, performing the functions both of the mouth and the anus; but in some presenting a digestive cavity with an orifice for the evacuation of its contents, distinct from that by which the food is taken in. In the 'Catalogue of the Physiological Series in the Museum of the Royal College of Surgeons in London' there are examples of both these modifications.

Illustrative of the first section, consisting of those Star-Fishes which have the digestive cavity simple, or without distinction of stomach and intestine, receiving and expelling its contents by the same orifice, we find No. 432, a preparation of a Star-Fish (*Asterias papposa*, Linn.; *Stella dodecactis*, Link; *Asterias helianthoides*, Pennant; *Stellonia papposa*, Agassiz; and *Solaster papposa*, Forbes). It exhibits the central orifice of the digestive cavity, and a portion of the integument has been reflected on the opposite side of the body, to show the numerous cæca continued from the degestive cavity. No. 433 presents a vertical section of the same species, showing the interior of the same cavity. In No. 434 the integument has been removed from the whole of the anterior part of the body of an *Asterias rubens*, Linn. (*A. glacialis* and *A. clathrata*, Penn.; *Stellonia rubens*, Ag.; *Uraster rubens*, Ag.), showing the membranous digestive cavity, containing some small bivalves. No. 435 is a specimen of *Asterias discoidea*, Lam., from which two rays have been removed, showing the singular and beautifully ramified form of the digestive cavity. The membranous pouches appear to be given off in two series, are sacculated, and strung, as it were, upon a mesentery.

The second modification is shown in No. 435 A, which presents the body of a Star-Fish (*Alecto glacialis*, Leach). Here the alimentary canal is continued in a spiral direction from the cental orifice or mouth, and terminates by a second direct orifice or anus, situated at the extremity of a fleshy tube, which projects forward by the side of the mouth.

De Blainville states that the liver is apparent and rather considerable in the Star-Fishes; it occupies the circumference of the stomach, forming bunches or racemi (des espèces de grappes), which are prolonged more or less into the cavity of the appendages when there are any; at least, he observes, such is the opinion of Cuvier, who is followed by Spix and Meckel. Delle Chiaje, on the contrary, regards these organs as a kind of stomachal cæca (and such an opinion seems to be strengthened by the preparations above noticed), and thinks that the liver is an irregular organ, situated on the upper part or dome of the stomach, of which no other author, according to De Blainville, makes mention, and which he himself had not observed. This organ is a racemose little bag of a yellowish-green or yellow colour, and its contents present a similarity to bile both to the sight and taste.

The very dilatable mouth and gullet of the Star-Fishes is admirably adapted for securing the testaceous mollusks and other animal substances on which the family feed. When the prey is apparently disproportioned to the parts into which it is to be conveyed, the œsophagus or gullet, together with part of the stomach itself, can be protruded and everted so as to draw the desired food into the cavity by the application of the everted surface to it. Thus, the shell-fish is swallowed whole, and specimens still living have been taken from the cavity. At other times the juices of the prey are sucked out, and the exhausted bivalve is left dead with its shell gaping. Not that the old supposition that the Star-Fish succeeded, in this last mode of feeding, by inserting a ray or finger into the gaping shell, and if it found the bivalve too strong for it, got rid of the difficulty and the ray at once, conscious of its power of reproducing another, seems to be at all founded in fact. Star-Fishes have been detected in the act of sucking the juices of *Conchifera* through perforations, and also with their mouths applied to the edges of the valves. From the apparently paralysed state of the bivalves found in such situations, it has been conjectured that the Star-Fish introduces some deleterious secretion within the valves, and thus leaves the mollusk torpid and deprived of the power of closing its valves against the attacks of its destroyer. Star-Fishes are considered, and not without reason, as great enemies to oyster-beds. But it is not on living prey alone that the Star-Fishes feed. They seem to assist materially in cleansing the sea from dead and decomposing animal matter. A human tooth has been found in the stomach of a Star-Fish.

Although there does not appear to be any special organ for respiration in the *Echinodermata*, the oxygenisation of the circulating fluid is extensively provided for by the exposure of the peritoneal cavity, and all the viscera, to the sea-water, which is freely admitted through membranous pipes, which have thence obtained the name of respiratory tubes. "These," says Dr. Sharpey, "communicate at their base with the interior of the body, and are perforated at the summit by an orifice which can be very accurately closed. Most of them are placed in groups or patches, and opposite each group the fibrous membrane, forming the wall of the body, presents on its inside a shallow pit perforated with holes, through which the tubes communicate with the internal cavity. The tubes are formed externally of the superficial layer of the skin, and are lined in the inside by a prolongation of the peritoneal membrane. This membrane lines the parietes of the body, and is reflected over the contained parts; at least it covers the stomach and cæca, and probably also the ovaries and vesicles of the feet; opposite the perforated pits it sends prolongations through the holes into the tubes, as may be easily seen on stripping off a portion of it. There can be no doubt that sea-water enters the peritoneal cavity. The animal slowly distends itself with that fluid, and again, but at no stated interval, gives out a portion of it. This is obvious from the fact that the same animal may be seen distended at one time and flaccid at another. Naturalists are generally of opinion that the water enters and issues by the respiratory tubes, and indeed no other orifices have been discovered. We must however freely own that we have never been able actually to observe its passage through these tubes. The peritoneal membrane seems to be the principal seat of respiration; spread over the viscera and the parietes of their containing cavity, and lining the respiratory tubes, it presents a great extent of surface continually in contact with the surrounding medium; and we have found that a beautiful provision exists for maintaining currents of water along the membrane, and thus effecting that constant renovation of the fluid in contact with its surface, which is required in the respiratory process. These currents are produced by means of cilia. Ciliary currents take place also on the external surface of the body, which probably partakes in the process of respiration. We have moreover observed them within the tubular feet, and on the internal surface of the stomach and cæca. In this last situation they are probably subservient to digestion." ('Cyclopædia of Anatomy and Physiology.')

Tiedemann and Delle Chiaje are the authorities from whom a knowledge of the circulating system of these animals is principally derived; but this part of their organisation is so obscure, that we need not be surprised at the difference which exists in the views of those observers. Thus, the true sanguiferous system is, according to Tiedemann, restricted in a great measure to the alimentary organs and ovaries, and he consequently supposes that the ducts which convey the fluid supplied to the feet afford nutrition to other parts of the body. In other words, he recognises two distinct systems of nutrient vessels; one a true sanguiferous system, consisting of vessels which carry blood, and the other a set of vessels (those of the feet) conveying a nutritious fluid secreted from the blood.

Delle Chiaje contends that the two orders of vessels above alluded to intercommunicate, and so form but one system.

Dr. Sharpey is disposed to conclude, from his own observations, that the vessels of the feet form a system apart from the blood-vessels, as Tiedemann maintained; but he observes that there is considerable reason to doubt whether, as that author supposes, they serve as the nutritious vessels of the parts in which they run; for, according to Tiedemann's description, it does not appear that they ramify in the tissues. Moreover, Dr. Sharpey adds, their contained liquid does not present the usual characters of blood, or of a fluid adapted to nourish the textures. He admits it to be true that there are floating particles suspended in it, but he states that the clear fluid, when filtered, yields no trace of animal matter, but agrees almost entirely in composition with sea-water. Such, at least, was the result of Dr. Sharpey's examination of it in the *Asterias*; and he proceeds to give an account of the proper sanguiferous system, following Tiedemann as his leading authority, but, at the same time, stating the more material points in which Chiaje differs from him, thus—

"In *Asterias*, a delicate vessel runs along the upper surface of each of the cæca. There are, of course, ten such vessels in *A. aurantiaca* (from which the description is taken), corresponding in number with the cæca. They commence near the extremity of the rays, and, receiving branches from the branches and lobes of the cæca, proceed to the central part of the animal, where they terminate in a circular vessel which runs round the upper part of the body on the internal surface. The circular vessel also receives ten branches from the ovaries, and five from the stomach, which, before joining it, unite into two. The vessels described seem to constitute the venous system, and Tiedemann further supposes that the cæcal and gastric veins convey the chyle or nutritious part of the food from the alimentary organs. The circular vein opens into a vertical canal, which descends along the prominent angle between the two rays, inclosed in the same membranous sheath with the sand-canal, and terminates in an inferior circular vessel. The descending canal is dilated in the middle; its comparatively thick brown-coloured parietes are smooth externally, but reticulated on the inside, and composed of interlaced fibres, which Tiedemann found to possess muscular irritability. He accordingly considers this canal as the heart. The inferior circular vessel (which must not be confounded with the circular canal connected with the feet) surrounds the month on the outside or inferior surface; it sends out five branches, which pass into the interior of the body, and are distributed to the stomach, cæca, and ovaries. Tiedemann regards these branches, with the circular vessel from which they proceed, as arteries, and he thinks it probable that their minute ramifications open into the radicles of the veins, though from their delicacy he has not been able to ascertain the fact by injection. Tiedemann's view of the function of the respective vessels is derived solely from a consideration of their anatomical disposition; and while in the same way it may be inferred that the blood circulates in a direction conformable with this view, it must nevertheless be kept in mind that no direct physiological proof of such a course of the blood has been yet obtained. Besides the vessels described, Tiedemann found yet another circular vessel surrounding the mouth on the under surface, and placed more superficially than the last mentioned; it is of an orange colour, and sends a branch along each of the rays in the groove which is on the middle of their inferior surface. He could trace no connection between this vessel or its branches and the rest of the vascular system, and he professes himself at a loss to conjecture what may be its function.

"According to Delle Chiaje, the circular vessel into which the canals of the feet open receives also the veins from the upper surface of the cæca and stomach. The same vessel, which he names the venous sinus, gives out—1, twenty short dental arteries; 2, the mesaraics to the under surface of the cæca; 3, five vertebral arteries which open into the vesicles of the feet; 4, the radial to the under part of each ray; 5, the dorsal arteries to the upper part of the ray, which extend their ramifications to the external surface of the body." ('Cyclopædia of Anatomy and Physiology.')

Professor Owen, in his Preface to the third volume of the 'Descriptive and Illustrated Catalogue of the Physiological Series of Comparative Anatomy contained in the Museum of the Royal College of Surgeons in London,' remarks, that when the nervous system begins to be distinctly eliminated in the form of fibres, it is accompanied by a distinct development of the muscular system; and the digestive canal is provided with a proper contractile tunic, and floats freely in an abdominal cavity. He observes that the nervous fibres in the classes of animals in which they are first discernible proceed from a ganglion or ganglions in the neighbourhood of the mouth, and extend in a radiated or longitudinal direction according to the form of the body, but are not afterwards brought into communication by ganglionic masses.

"The Echinoderms, as the Star-Fish and Sea-Urchins," writes the Professor, "first present these conditions of the nervous, muscular, and digestive systems. A very gradual transition from the radiated to the elongated form is traceable from this class through the *Holothuriæ* and *Sipunculi* to the cavitary *Entozoa* or *Cœlelmintha* (intestinal worms having an abdominal cavity), and thence to the *Epizoa* and *Rotifera*, which make a near approach to the annulose division of the animal kingdom; but at the same time do not possess that structure of the nervous system which is its true characteristic. The four classes of animals, thus distinguished by a common character of the nervous system from the *Acrita* on the one hand, and the *Articulata* on the other, constitute a second division of the animal kingdom, which may be termed *Protoneura*."

The preparation No. 1292 A, in the series illustrative of the nervous system of the *Nematoneura* is a Star-Fish (*Asterias papposa*, Lam.) with the membrane removed from the oral surface of the central disc, to show the simple nervous chord surrounding the mouth and distributing filaments to each ray. These filaments run in the interspace of the tubular feet, extending from between the spines which protect the ambulacral grooves. ('Catalogue.')

Tiedemann, who discovered the nervous system in these animals, describes it in *Asterias aurantiaca* as composed of a delicate white chord surrounding the mouth, in form of a ring immediately on the external side of the circular vessel into which the heart opens, and of filaments arising and diverging from the annular chord opposite to the rays—three filaments for each ray—one running along the under surface in the median line, and appearing to send small branches to the feet; the other two, shorter, passing between the first and second segment of the ray into the interior of the body, and probably distributed over the stomach. No ganglia were discovered by Tiedemann, but minute ganglia have been described by others as existing at the points whence the diverging filaments spring. (Grant's 'Comp. Anat.')

All of course agree in assigning the sense of touch to the Star-Fishes, but many would confine their endowment to that sense. Professor Ehrenberg however, who is a keen and accurate observer, is disposed to think that some of them at least are gifted with visual organs under the form of a single red speck at the termination of each ray. These specks had been long noticed, but without any determinate conjecture as to their use in the animal economy, till he, struck by their outward resemblance to the eyes of the *Entomostraca* and *Infusoria*, thought that they might be organs of sight, and he traced the long nerve of the ray up to the extremity, where it enlarges into a sort of ganglion connected with the red speck.

Professor Rymer Jones, after noticing the nervous system of these animals, thus expresses his dissent from Professor Ehrenberg's views: "Such an arrangement can only be looked upon as serving to associate the movements performed by the various parts of the animal, for no portion of these simple nervous threads can be regarded as being peculiarly the seat of sensation or perception. But this inference is not merely deducible from an inspection of the anatomical character of the nerves: it is based upon actual experiment. We have frequently, when examining these animals in a living state—that is, when, with their feet duly developed, they were crawling upon the sides of the vessel in which they were confined—cut off with scissors successive portions of the body so as to expose the visceral cavity; but so far from the rest of the animal appearing to be conscious of the mutilation, not the slightest evidence of suffering was visible: the suckers placed immediately beneath the injured part were invariably retracted; but all the rest, even in the same ray, still continued their action, as though perfectly devoid of participation in any suffering caused by the injury inflicted. Such apathy would indeed seem to be a necessary consequence resulting from the deficiency of any central seat of perception whereunto sensations could be communicated; nevertheless Ehrenberg insists upon the existence of eyes in some species of the star-fish, attributing the function of visual organs to some minute red spots visible at the extremity of each ray, behind each of which he describes the end of the long nerve which runs along the ambulacral groove as expanding into a minute bulb. We must however confess that the proofs adduced in support of such a view of the nature of these spots appears to us to be anything but satisfactory; and as we have already stated in the first chapter the physiological objections which may be urged against the possibility of any localised organ of sense being co-existent with a strictly nematoneurose condition of the nervous system, they need not be repeated here. The general sense of touch in the *Asteridæ* is extremely delicate, serving not only to enable them to seize and secure prey, but to recognise its presence at some little distance, and thus direct these animals to their food. A person who has been in the habit of fishing with a line in the shallow bays frequented by star-fishes, and observed how frequently a bait is taken and devoured by them, will be disposed to admit this; yet to what are we to attribute this power of perceiving external objects? It would seem most probably due to some modification of the general sensibility of the body, allowing of the perception of impressions in some degree allied to the sense of smell in higher animals, and related in character to the kind of sensation by which we have already seen the *Actiniæ* and other polyps able to appreciate the presence of light, although absolutely devoid of visual organs." ('General Outline of the Animal Kingdom and Manual of Comparative Anatomy.')

Professor Edward Forbes, although he admits that the existence of ganglions in the nervous system of these animals is generally regarded as doubtful, seems, from the frequent recurrence of the terms 'eye' and 'eyelid,' to be of opinion that the specks above alluded to are visual organs. ('History of British Star-fishes and other Animals of the Class Echinodermata.')

Our own opinion and observation are in favour of the views of Ehrenberg; and we think that those who have accurately watched the Star-Fishes which are furnished with these specks on the sea-coast will in general be irresistibly led to the conclusion that the organs, though not eyes in the strict sense of the term, serve the purposes of vision modified to the exigencies of the animal, enabling it to seek or avoid objects according to its will. Nor does analogy, in our view of the case, present any difficulty. We have only to consider that the centre is a head as well as a stomach, a condition that will hardly be denied to it, and the rays proceeding from it may be viewed as so many antennæ—(take those of the snail for example, with their terminal ocular points, as in some degree analogous)—with visual dots at their extremities. This, at all events, may solve the problem of the destructive visitation of these animals to the baited line, more in unison with the analogies than the supposed existence of a general olfactory sense, of whose presence not the slightest trace has been observed.

The muscular system is generally present in the *Echinodermata*, but the organs of motion in them are various. The rays themselves are moveable, and in the free forms aid in the removal of the animals from place to place. Thus the common Star-Fish can bend its rays towards the upper or towards the lower surface of the centre or disc, and can approximate some while it extends others; so that they are widely divaricated laterally, and thus facilitate its advance in the water, or its passage through small spaces. In the common Star-Fish these motions are slow, but in *Ophiocoma* they are comparatively rapid, and manifested in active contortions on some occasions. According to M. Sars, the young of *Asterias sanguinolenta*, which have four short club-shaped appendages or arms at their anterior extremity, move slowly but uniformly in a straight line with their fore arms foremost. Vibratile cilia are supposed to form the moving power in this case: the arms also enable the little animal to creep at a slow pace along the rocks. When the animal is more fully developed the power of swimming ceases.

Tiedemann considers that the power of moving the rays resides in the contractile skin. Meckel states that there are distinct muscles leading between the calcareous plates which form the floor of the rays. Dr. Sharpey has no doubt that the motions are partly effected by the skin, but he had himself observed a distinct band of muscular fibres running along the roof of each ray, between the coriaceous skin and peritoneal membrane when it is stripped off.

But the principal locomotive organs of the *Echinodermata* are the membranous tubes which can be protruded at will through the ambulacral apertures, and which have been termed the feet. The clearest description of this complicated and in some degree obscure apparatus known to us is that by Dr. Sharpey; and we therefore give it in his own words.

"These," writes Dr. Sharpey, treating of the membranous tubes or feet, "are very numerous, and are usually disposed in regular rows: they contain a clear fluid, which is conveyed to them by a peculiar system of vessels. Each foot consists of two parts, an internal and generally vesicular portion placed within the body, and a tubular part on the outside projecting from the surface, and continues with the first through an aperture in the skin or shell. The tube is closed at the extremity, and terminates there in a sucker, which has usually the form of a disc slightly depressed in the centre. Both parts of the foot are evidently muscular, the fibres of the tubular portion being disposed in a circular and longitudinal layer; the cavity is lined with a transparent membrane, and the tubular part moreover receives an external covering from the epidermis. The foot is extended by the contraction of its internal vesicle, which forces the fluid into the tube; or when a vesicle is wanting, by the projection of a fluid into the tube from a communicating vessel. The tubular part is thus distended and elongated; it retracts itself of course by its muscular fibres; and when this takes place the fluid is forced back again into the vesicular or internal part. In progression the animal extends a few of its feet in the direction in which it desires to go, attaches the suckers to rocks, stones, or other fixed objects immediately in advance; then shortening its feet it draws its body in the wished-for direction. In the star-fish the feet are disposed in rows along the under surface of the rays, diminishing in size as they approach the extremity. There are usually two simple rows in each ray, and the vesicular part is for the most part deeply cleft into two lobes, as in *A. aurantiaca*. In other cases, as *A. rubens*, there are two double rows in every ray, and each foot has a round undivided vesicle. The canals or vessels which convey the fluid to and from the feet are all connected with a circular vessel situated in the vicinity of the mouth. This vessel lies immediately within the calcareous ring already described as connecting the rays at the commencement; from it a straight canal proceeds along the floor of each ray in the median line, and in its progress gives off lateral branches, which open into the vesicles of the feet. There are moreover connected with the circular vessel—First, a certain number of bodies (ten in five-rayed species) which Tiedemann compares to glands; they are very small, brown, sacculated organs, each opening by a small orifice into the circular vessel: Tiedemann supposes them to be the source from which the fluid filling the feet is derived. Secondly, pyriform sacs: in *A. aurantiaca* there are four groups of these; and each group consists of three or four sacs, which open by a common tubular pedicle into the circular vessel. In some other species there are five simple sacs. They are muscular, and Tiedemann conceives them to be the chief agents by which the fluid is forced into the vesicles of the feet, to which they are placed in a sort of antagonism. It would seem however that this purpose may be accomplished by other means; for according to Meckel's statement, and we may add our own observation, they are not present in all species. Lastly, the circular vessel receives the singular organ named the stone-canal or sand-canal by Tiedemann, who describes it as a membranous canal containing a friable mass of sandy or earthy matter, which commences by a wide origin on the inferior or internal surface of the calcareous disc already described as situate on the upper part of the body, descends in a duplicature of fibrous membrane, and opens by a narrow orifice into the circular vessel, the upper or wide end being closed by the disc. Ehrenberg has correctly remarked that this organ is not filled with an amorphous mass of earthy or cretaceous matter: he describes it as exhibiting a dense net-work of calcareous fibres, with hexagonal and pentagonal meshes, resembling in some respects the cavernous structure of the penis. The result of our own examination, in more than one species, is different still. We have always found the earthy matter forming a jointed calcareous tube. This tube, which is about the thickness of a surgeon's probe, is composed of rings of calcareous substance connected by membrane, so that viewed externally it is not unlike the windpipe of a small animal. On cutting it across however it is found to be more complex in structure than appears externally; for it contains within two convoluted laminæ of the same nature as its calcareous parietes. These laminæ are rolled longitudinally: they rise conjointly, or as one, from the internal surface of the tube, pass inwardly a certain way, then separating, are rolled in opposite directions, something after the same manner as the inferior turbinated bone of the ox. These internal laminæ become more convoluted towards the upper end, where at last they, as well as the more external part of the tube, join the dorsal disc, appearing gradually to become continuous with its substance. The disc is perforated with numerous pores, which open into the tube. Tiedeman conceives the function of the sand-canal to be that of secreting the earthy matter required for the growth of the calcareous skeleton. Meckel considered this view as very improbable, and the description we have given does not tend to corroborate it. We must confess ourselves unable to offer more than mere conjecture as to the use of this singular structure. If the fluid contained in the feet and their vessels be sea-water (either pure or with an admixture of organic particles), which is probable from its chemical composition, may it not be introduced, and perhaps again discharged, through the pores of the disc and the calcareous tube, the porous disc serving as a sort of filter to exclude impurities?" ('Cyclopædia of Anat. and Physiol.')

The reproduction of the *Echinodermata* appears to be monœcious, of that nature which Professor Owen terms cryptandrous hermaphroditism. Ovaries are, as far as we are aware, the only organs relating to the generative functions hitherto discovered; but Fabricius, in his 'Fauna Grœnlandica,' would seem to affirm that two individuals are necessary for the propagation of the species, and states that union takes place in the month of May—"congreditur oribus arctè connexis, altera supina." The ovaries, which appear to vary in number in different species, form in general an oblong cluster of tubes branching from a single stem, by which the whole is attached, and ending in circular dilated vesicles. In some species, *Asterias aurantiaca* for instance, the tubes form numerous bundles (about twenty), each of which is distinctly attached, so that they are not all connected by a single stem. In the Museum of the College of Surgeons, London, No. 2236 is a portion of a Star-Fish (*A. rubens*, Lam.) prepared to show the ovaria, ten in number, attached on each side of the base of each ray, near the angle of divergence; the ova are not developed in this specimen. No. 2237 exhibits an *A. papposa*, Lam., with the anterior parietes of one ray and the posterior parietes of another ray, dissected off, showing the ovaria with the ova at the commencement of their development. The ovaria are two in number in each ray, as in the preceding species, and are similarly attached on each side of the base of the ray, where they may be distinguished from the digestive and locomotive cæca by their greater opacity and granular structure. No. 2238 is the same species with the posterior parietes of the central disc removed, showing the commencement of the digestive cæca and the ovaries. No. 2239 is a portion of one of the rays of *Comatula solaris*, Lam., showing the ovarian receptacles occupying the inner side of each of the pinnæ, or articulate processes sent off from the rays. Three of the receptacles are laid open to expose the contained ova. ('Catalogue Physiol. Series.')

M. Sars states that the young of *A. sanguinolenta* immediately after birth have a depressed and rounded body, with four very short club-shaped appendages or arms at their anterior extremity, as above stated. When they are a little more developed papillæ disposed in five radiating rows on the upper surface may be distinguished. At the expiration of twelve days the five rays of the body, which up to that time had been rounded, begin to increase; and at the conclusion of eight days more the two ranges of feet or tentacula are developed under each ray, and assist in the locomotion of the animal by alternate elongation and contraction and performing the office of suckers.

The integuments of a Star-Fish are—1, a leather-like tough membrane in which portions of calcareous matter, which may be termed the skeleton of the animal, are imbedded; 2, an external membrane of a softer texture; 3, certain appendages. "The calcareous pieces," writes Dr. Sharpey, 'Cyclo. of Anat. and Physiol.,' "form inferiorly a ring round the mouth and a series of transverse segments placed in succession along the floor of each ray. The first of these segments is connected with the ring; they decrease in size as they approach the point or distal end of the ray, and openings are left between them for the passage of the feet. In the *Asterias rubens*, which has five rays, the central ring consists of ten larger and five smaller pieces, the former disposed in pairs opposite the commencement of the rays, the latter corresponding to the angles between the rays. The segments of the rays are symmetrical; in the species mentioned they consist of two oblong pieces united in the median line, and two smaller ones placed laterally. On the sides of the ray the calcareous substance is disposed as it were in ribs; these rise from the floor at first nearly parallel with each other, and are connected by cross bars, but on approaching the upper part or roof of the ray they cross in all directions and form an irregular net-work, the intervals of which are occupied by softer integument. The ribs and bars are made up of small pieces joined by plane but oblique surfaces, a mode of construction calculated to admit of their being lengthened and shortened upon one another, and thus to allow the cavity they surround being dilated and contracted. A broad calcareous disc is situated on the upper surface of the body in the angle between two of the rays, which is connected internally with the sand-canal. The calcareous pieces are of a homogeneous structure without cells or fibres; they consist, according to Hatchett's analysis, of carbonate of lime, with a smaller proportion of phosphate of lime. The coriaceous membrane which connects the pieces of the skeleton is made up of white glistening fibres. It is contractile and irritable, for it slowly shrinks on being scratched with tho point of a knife, or when it is cut through. The external membrane is much thinner and softer than that just described; iu various parts it is coloured, or in these parts there is a coloured layer underneath it. The appendages or processes on the surface of the body are of three kinds. First, calcareous spines; these are found over the whole surface, except the grooves for the feet. They are attached by a moveable joint at their base to the calcareous pieces of the skin, and are invested by the external soft membrano nearly as far as their point. Those on the upper surface are solitary, short, and for the most part club-shaped, their broader summit being marked with radiating points; whence thoy were named stelliform processes by Tiedemann. On each side of the groove for the feet the spines are thickly set; these in *A. rubens* have three rows, in the middle and innermost of which they are placed three deep. On this part of the surface they are also longer and pointed. The spines are slowly moved at the will of the animal. The appendages of the second kind are of a very singular nature; they have the appearance of pincers of crab's claws in miniature, and were described by Müller as parasitical animals under the name of *Pedicellaria*. Monro gave the name of antennæ to analogous organs which are found on the Sea-Urchin. They probably do not exist in all species, for Tiedemann makes no mention of them in his description of *A. aurantiaca*. In *A. rubens* they cover the surface generally, and form dense groups round the spines. Each consists of a soft stem, bearing on its summit, or (when branched) at the point of each branch, a sort of forceps of calcareous matter not uulike a crab's claw, except that the two blades are equal and similar. When the point of a fine needle is introduced between the blades, which are for the most part open in a fresh and vigorous specimen, they instantly close and grasp it with considerable force. The particular use of these prehensile organs is not apparent; their stem, it may be remarked is quite impervious. The third sort of appendage consists of thoso which are named the respiratory tubes." In the other *Echinodermata* the same general construction of the skeleton may bo observed; but the modifications differ with the forms. In some it consists of hundreds of pieces disposed in various patterns, and fitting with the most minute accuracy. In some these pieces are soldered together, as in the calcareous central purse from which the arms of the *Ophiuræ* radiate; and in others they are united by ligaments, as in the rays of these *Ophiuræ*, the *Gorgonocephali*, and the *Encrinites*.

The sudden and voluntary act of dismemberment by which many of the *Echinodermata* will save their central disc at the expense of their rays or arms, must have struck those who have observed these animals in their uative seas, as well as the length of time during which the sovered parts still continue to be endowed with motion. This power of dismemberment seems to bo carried to its fullest extent in *Ophiocoma* and *Luidia*. The following account by Professor E. Forbes of an attempt to capture a species of tho last genus is a good illustration of this property:—

"It is the wonderful power which the *Luidia* possesses, not merely of casting away its arms entire, but of breakiug them voluntarily into little pieces with great rapidity, which approximates it to the *Ophiuræ*. This faculty renders the preservation of a perfect specimen a very difficult matter. Tho first time I ever took one of these creatures I succeeded in getting it into the boat entire. Never having seen one before, and quite unconscious of its suicidal powers, I spread it out on a rowing bench, the better to admire its form and colours. On attempting to remove it for presorvation to my horror and disappointment I fonnd only an assemblage of rejected members. My conservative endeavours were all neutralised by its destructive exertions, and it is now badly represeuted in my cabinet by a discless arm and an armless disc.

"Next time I went to dredge on the same spot, determined not to be cheated out of a specimen a second time, I brought with me a bucket of cold fresh water, to which article star-fishes have a great antipathy. As I expected, a *Luidia* came up in the dredge, a most gorgeous specimen. As it does not generally break up before it is raised above the surface of the sea, cautiously and anxiously I sunk my bucket to a level with the dredgo's mouth, and proceeded in the most gentlo manner to introduce *Luidia* to tho purer clement. Whother the cold air was too much for him or the sight of the bucket too terrifio I know not, but in a moment he proceeded to dissolve his corporation, and at every mesh of the dredge his fragments were seen escaping. In despair I grasped at the largest, and brought up the extremity of an arm with its terminating eye, the spinous eyelid of which opened and closed with something exceedingly liko a wink of derision. Young specimons are by no means so fragile as those full grown, and tho five-armod varicty secins less brittle than that with seven arms. Like other star-fishes it has the power of re-producing its arms."

With regard to the power of restoration, few collectors have not come into possession of a specimen with a budding or growing ray occupying the place of a lost one. [ENCRINITES.] Jussieu, Guettard, and Gerard de Villars brought to Reaumur specimens of Star-Fish with four large rays and a small one still growing; they found others, he tells us, with only three large rays and two very small ones; and others with two largo rays and threo very small, and, as it seemed, very young ones. Moro than once they met with a large ray from which four young rays had begun to sprout. Reaumur speaks of the fact as being well known to the fishermen, and in allusion to certain experiments which Jussieu and Guettard had been carrying on he remarks that the portious into which they had divided the animals appeared to go on well, the wounds healed and consolidated; but he adds that those who made the experiment were obliged to limit their stay on the coast to about fifteeu days—too short a period, he observes, to trace the progress of a reproduction which apparently requires several months, or perhaps even more than a year for its completion.

Although the *Echinodermata* have so great a power of reproducing lost parts, they present no indications of any power of increasing separate individuals by gemmation as witnessed in the *Acalephæ* and lower animals. As in the *Acalephæ*, the embryo of the *Echinodermata* pass through several forms before arriving at maturity. The following is an outline of the process in the *Asteriadæ*:—"From the accounts of the development given by different trust-worthy observers, there can be little doubt that the process takes place after at least two very diverse plans. The first and simplest of these has been witnessed by Sars in the *Echinaster rubens*; and the observations of Agassiz are on the whole in accordance with those of that industrious naturalist. In the early stages the segmentation of the yoke takes place as in other animals; and the embryo comes forth from the egg soon after it has attained the state of the 'mulberry mass,' and swims freely about, by means of the cilia with which it is covered, in a sort of marsupial chamber which is formed by the drawing together of the rays of the parent around its mouth. Soon after its emersion, the embryo begins to put forth an organ of attachment, resembling the stem of a Crinoid; this at first possesses two tubercles, then three, then four, with a fifth smaller one between them. At tho same time, the principal mass becomes flatteued, and shapes itself into five lobes surrounding a central disc; thus sketching out the body and rays. When in this state it attaches itself to fixed objocts by its organ of adhesion; but if detached, it swims through the water by the action of the cilia with which the body and arms are clothed; so that it bears a strong analogy to the *Pentacrinus* in process of conversion into a free moving *Comatula*. At the same time, five double rows of small tubercles may be perceived radiating from the centre of what is to become the ventral surface of the body; these gradually elongate themselves, and become cirrhi, each furnished with a sucker at its extremity. A peculiar tubercle is also seen at the edge of each of the five lobes of the body; and this is the rudiment of the ocellus, which is afterwards found at the extremity of each ray. As development proceeds, the primitive organ of adhesion gradually decreases iu size, and the animal creeps by means of its cirrhi; and at last tho pedicle is drawn (as it were) into the body, the lobes of the body lengthen into rays, the animal loses its ciliograde progression, and the ordinary characters of the Star-Fish become apparent. The progress of the internal organisation is thus described by Agassiz:—'The earliest deposit of calcareous matter takes place around tho prominent tubercles of the lower surface; at first in the condition of little isolated crystals, which are formed as nuclei in tho cells; and then as a network formed by the coalescence of several of these. Of these networks there are at first ten, symmetrically disposed on the ventral surface, in a manner corresponding to the arrangement of the solid plates in Crinoids; but they gradually increase in number, and more distinctly mark out the rays; new ones being interposed in pairs between those already existing, and small spines projecting from the older ones. The calcareous deposit in the dorsal surface, on the other haud, seems to proceed from a central nucleus above tho yolk-mass. The progress of development is obviously from without inwards; the cells ou the surface of the yolk-mass being the first to undergo metamorphosis into the permaneut structure. Those occupying the central part of the body and pedicle undergo liquefaction, and a kind of circulation is seen in the latter. Gradually what remains of the yolk-mass is more distinctly circumscribed in the interior of the animal, and forms a central cavity with prolongations extending into the rays; but it is not until the pedicle has contracted itself iuto a mere vesicle that the mouth is formed, by the thinning-away of tho envelope of the yolk-mass on the lower surface, a little to one side of the base of the pedicle; and it is not until after the formation of the mouth, that tho nervous ring can be traced, with its prolongations extending to the ocelli at the extremities of the rays.'

"The second plan of development seems much more conformable to what will be presently described as taking place in the *Ophiuridæ* and *Echinidæ*; for the body first developed from the embryonic mass is a larva, of which little remains in the pormanent structure, and the Star-Fish is budded off, as it were, from the anterior extremity of this. This larva, which has received the name of *Bipinnaria* from the symmetrical wing-like arrangemeut of its natatory organs, presouts much more resemblance to an Articulated, or to a Vertebrated, than to a Radiated animal. Its body is elongated, and carries at its antorior extremity the portion of the yolk-mass not yet metamorphosed, from which the Star-Fish is afterwards to be developed; and into the cavity of this a passage is formed, through what may be termed the mouth of the larva, which opens in the middle of a transverse furrow, whilst another tube passing forth from it seems to answer to an intestine. On either side of the anterior portion of the body are six or more narrow fin-like appendages, which are fringed with cilia; and the posterior part of the body is prolonged into a sort of podicle, bilobed towards its extremity, which also is covered with cilia. The organisation of this larva seems completed, and its movements through the water are very active, before the mass at its anterior extremity presents anything of the aspect of the Star-Fish; in this respect corresponding with the movements of the Pluteus of the *Echinidæ*. The temporary mouth of the larva does not remain as the permanent mouth of the Star-Fish; for it is on what is to become the dorsal side of the body; and the true mouth is subsequently formed by the thinning away of the integument (which has completely inclosed the yolk-mass) on the ventral surface. The young Star-Fish is separated from the bipinnarian larva, by the forcible contractions of the connecting pedicle, as soon as the calcareous consolidation of its integument has taken place, and its true mouth has been formed, but long before it has attained the adult condition; and as its ulterior development has not hitherto been observed in any instance, it is not yet known what are the species in which this mode of evolution prevails. The larva continues active for several days after its detachment; but there is no reason to believe that its existence is prolonged for any considerable time; and as the Star-Fish is not formed by gemmation from it, but from a portion of the yolk-mass which remained unconsolidated after its completion, it is obvious that the larva does not stand in the same relation to the Star-Fish, as the hydraform polype to its medusa-bud." (Carpenter, 'Principles of Physiology.')

Müller ('Ueber die Larven und die Metamorphose der Echinodermen,' 1848) has also described the process of embryonic development in the *Ophiuridæ* and *Echinidæ*. In these the embryo issues forth from the ovum as soon as it has attained by the repeated segmentation of the yolk the condition of the 'mulberry mass,' and the superficial cells of this are covered with cilia, by whose agency it swims freely through the water. So rapid are the processes that not more than 24 hours elapse between fecundation and the exit of the embryo. Shortly after its emersion the embryo changes from the spherical into a sub-pyramidal form with a flattened base; and in the centre of this base is a depression, which gradually deepens so as to form a mouth that communicates with a cavity in the inside of the mass. The pyramid is at first triangular, but it afterwards becomes quadrangular, and the angles are greatly prolonged round the mouth (or base), whilst the apex of the pyramid is sometimes greatly prolonged in the opposite direction, but is sometimes rounded off into a kind of dome. This body is strengthened by a frame-work of thread-like calcareous rods. In this condition the embryo swims freely through the water propelled by the cilia which clothe the angles, and the projecting arms. The creature has at this stage received the name of Pluteus. The Pluteus of the *Ophiura* and *Echinus* differ but little at first in their general form and structure. Each species however has its distinctive characters. In this stage the Pluteus resembles the *Acalephæ*; its probosciform mouth resembling the *Medusæ* and its cilia the *Beröe*. [ACALEPHÆ.] The Pluteus gradually loses its Acalephoid characters, the jaws and teeth and calcareous plates slowly developing; and it thus passes into its true Echinodermatous form.

Systematic Arrangement.—Most systematists have given classifications of the *Echinodermata*.

Link, in his volume 'De Stellis Marinis' (fol., Leipzig), arranges and figures a considerable number of species, in the method of which the outline is here given.

Section I. *De Stellis Fissis.*

Class 1. *Oligactis* (Star-Fishes with fewer than five rays).
Genera, *Trisactis*, *Tetractis*.
Class 2. *Pentactinodos* (Quinquefid Star-Fishes).
Genera, *Pentagonaster*, *Pentaceros*, *Astropecten*, *Palmipes*, *Stella coriacea*, *Sol marinus*, *Pentacdylosaster*.
Class 3. *Polyactinodos* (Multifid Star-Fishes).
Genera, *Hexactis*, *Heptactis*, *Octactis*, *Enneactis*, *Decactis*, *Dodecactis*, *Triscaidecactis*.

Section II. *De Stellis Integris.*

Class 1. *Stellarum Vermifermium.*
Genera, *Stella lumbricalis*, *Stella scolopendroides*.
Class 2. *Stellarum Criniterum.*
Genera, *Decacnemos*, *Triscaidecacnemos*, *Caput-Medusæ*.
Class 3. *Astrophyton.*
Genera, *Arachneides*, *Astrophyton costosum*, *Astrophyton scutatum*.

Linnæus divided his genus *Asterias* into the following sections:—

1. *Integra.*—Example, *Asterias Luna*, the only species.
2. *Stellatæ.*—This section contained nine species. Example, *Asterias papposa*.
3. *Radiatæ*—Containing six species. Examples, *Asterias Ophiura*, *A. Caput-Medusæ*.

Position of the genus between *Medusa* and *Echinus*.

Gmelin arranged the genus in three sections also, retaining the names of Linnæus for the last two; but altering that of the first, under which he includes four species, to *Lunatæ*.

Position of the genus, between *Physsophora* and *Echinus*.

Lamarck, who, according to De Blainville, "a suivi à peu près les erremens de Link dans la distribution systematique des Stellérides," arranged them as the first section or family of the Echinodermatous *Radiata*, and separated them into the genera *Comatula*, *Euryale*, *Ophiura*, and *Asterias*.

Ophiura is divided by Lamarck into two distinct sections; 1st, Those species which have the rays rounded or convex on the back, 2nd, Those species which have the rays flattened on the back, that is, above as well as below. Then comes a crowd of species under the title of "Espèces que je n'ai point vues."

Agassiz divides the *Ophiuræ* into five sections:—

1. *Ophiura.*—Those species which have the disc very much depressed, the rays simple, scaly, and furnished with very short spines, and embracing or close down upon the rays. Examples, *Ophiura texturata*, *O. lacertosa*, Lam.
2. *Ophiocoma.*—Those species which differ from the preceding by having very long and moveable spines upon the rays. Examples, *Ophiura squamata*, *O. echinata*, Lam.
3. *Ophiurella* (Fossil only).—Those species whose disc is hardly distinct. Examples, *Ophiura carinata*, Münst.; *O. Egertoni*, Brod.
4. *Acroura* (Fossil only).—Differing only from *Ophiura* in having spines on the sides of the rays instead of scales; while the rays themselves are very slender. Examples, *Ophiura prisca*, Münst.; *Acroura Agassiz*, Münst.
5. *Aspidura* (Fossil only).—Having the upper surface of the disc covered by a star of ten plates, whilst the rays, which are proportionally stout, are surrounded by imbricated scales. Example, *Ophiura loricata*, Goldf.

Asterias is arranged by Lamarck under the following divisions:—

1. Those species which have the body scutellated. These are numerous, and comprise the genera *Scutaster*, *Plataster*, *Palmaster*, and *Solaster* of De Blainville.
2. Those which have the body radiated, consisting of numerous species also, and comprising the genera *Solaster* and *Pentaster* of De Blainville.

The *Stelleridæ*, in Lamarck's arrangement, are immediately followed by the *Echinidæ*.

Cuvier makes the Echinodermes the first class of Zoophytes, and the Pédicellés the first order of that class, observing that Linnæus established three genera of them (meaning apparently the three divisions above stated), which are very natural, but numerous enough, and comprise species sufficiently varied to be considered as three families.

Cuvier divides the species into:—

Les Astéries (*Asterias*, Linn.), commonly called Sea-Stars. He recognises some of the genera of Leach and Lamarck, and observes that the *Encrinites* (*Encrinus*, Guettard) ought to be placed near the *Comatulæ*.

The Oursins (*Echinus*, Linn.) immediately follow the Sea-Stars.

De Blainville divides the Stelliridians into three families:—1. Those with a stelliform body; 2, those with a disciform body; 3, those with a cupuliform body.

I. Asteridians.

Genus *Asterias*, comprising the following divisions or sub-genera:—

A. Species whose body is pentagonal, and but little or not at all lobated on its circumference; the angles being fissured (Les Oreillers). Example, *Asterias Luna*.

B. Pentagonal species: delicate, and, as it were, membranous (Les Palmastéries—*Palmipes* of Link).

C. Quinquelobated species, which are not articulated on the circumference. Example, *Asterias minuta*, Linn. (*Pentaceros*, Link; *Asterina*, Nardo.)

D. Pentagonal species more or less lobated and articulated at their circumference (Les Scutastéries, ou Platastéries). Example, *Asterias tessellata*. [ASTERIAS.]

De Blainville remarks that the species of this section, many of which exist in the European seas, do not appear to him to have been examined by zoologists with sufficient accuracy; and he thinks that many species have been confounded under the same name.

E. Species deeply divided into five rays (Pentastéries).

*

Triangular, depressed, and articulated on the edges (*Astropecten*, Link.; *Crenaster*, Llhuyd). Example, *Asterias aranciaca*, Linn.

* *

Triangular, rather short, and rounded above. Example, *Asterias rubens* Linn. (*Uraster*. Ag.)

* * *

Rays long, strait, and often narrowed at their origin. Examples, *Asterias variolata*; *A. granifera*, Lam.

De Blainville remarks that the species which enter into this section are numerous, but that their distinction is not yet sufficiently established. He is certain, for example, that four species have been confounded under the name of the Fringed Star (Astérie Frangée). On the other hand, he thinks that those of the last section may have been too greatly multiplied.

F. Species which are divided into a greater number of rays than five or six (Solastéries). Examples, *Asterias tenuispina; A. endeca; A. papposa.*

II. Asterophidians.

Genera, *Ophiura*, *Euryale.*

Ophiura.

A. Species the spines of whose rays are very short, and applied upon the latter. Example, *Ophiura texturata*, Lam.

B. Species the spines of whose rays are long, and not applied upon the latter. Example, *Ophiura squamata*, Lam. [OPHIURA.]

Euryale.

A. Species whose rays dichotomise but little, and far from the root. Example, *Euryale palmifera*, Lam.

B. Species whose rays divide and dichotomise from the base. Example, *Euryale scutata.* [OPHIURA.]

III. Asterencrinidians.

1. Free Asterencrinidians. Example, *Comatula.* [COMATULA.]
2. Fixed Asterencrinidians.

Genera, *Encrinus; Phatocrinus; Pentacrinus; Apiocrinites; Poteriocrinites; Agathocrinites; Actinocrinites; Rhodocrinites; Platycrinites; Caryocrinites; Marsupites; Pentremites.* [ENCRINITES.]

Agassiz also divides the Stellirideans into three families or principal sections, but he gives them different names.

1st. Asterians, consisting of those species which have for their digestive organ a single orifice surrounded by suckers, but deprived of teeth; a madreporiform tubercle on the back between the two posterior rays, and deep furrows occupied by many rows of pedicles, going from the mouth to the extremity of the arms.

2nd. Ophiurians, comprising those whose body forms a flattened and distinct disc, to which are annexed more or less elongated or even ramified rays, deprived of furrows on their lower surface.

3rd. The Crinoidians, having two separate, but closely approximated orifices to the intestinal canal; and being for the most part fixed by the dorsal surface, by means of an articulated pedicle.

Before we enumerate the genera into which this zoologist divides *Asterias*, we must notice the division of M. Nardo, who had previously proposed the following:—*Stellaria* (*A. aranciaca*—*A. calcitrapa*); *Stellonia* (*A. rubens*—*A. glacialis*); *Asterina* (*A. exigua*—*A. minuta*); *Anseropoda* (*A. membranacea*—*A. rosacea*); *Linkia* (*A. lævigata*—*A. variolosa*).

The following is the division of Agassiz.

1. *Asterias* (*Astropecten*, Link; *Crenaster*, Llhuyd.; *Pentaster*, Bl.; *Stellaria*, Nardo).
2. *Cœlaster*, Ag., differing from the preceding in having the interior cavity circumscribed by plates disposed like those of the *Echini*, at the summit of which may be perceived a star with ambulacra. A genus approaching the Crinoidians in its organisation, whilst its general form is that of the true Star-Fishes. Example, only one species, and that fossil, *C. Couloni*, Ag.
3. *Goniaster*, Ag. (*Scutaster* or *Plataster*, Bl.). Examples, *Asterias tessellata*, Lam., *A. equestris*, Linn.
4. *Ophidiaster*, Ag. Example, *A. ophidiana*, Lam.
5. *Linkia*, Nardo. Example, *A. variolata*, Lam.
6. *Stellonia*, Nardo, (*Pentaster* in part and *Solaster* in part, Bl.). Examples, *A. rubens; A. glacialis; A. endeca; A. papposa; A. Helianthus*, &c.
7. *Asterina*, Nardo (*Asterias*, sect. C., Bl.; *Pentaceros*, Link). Example, *A. minuta.*
8. *Palmipes*, Link (*Palmaster*, Bl.; *Anseropoda*, Nardo). Example, *A. membranacea.*
9. *Culcita*, Ag. (*Oreiller*, Bl.). Example, *A. discoidea.*

In 1840 Müller of Berlin read his paper on the genera of Star-Fishes to the Berlin Academy, in which the anus or anal pore is employed as characteristic of family distinction. This aperture is described as present in all Star-Fishes, excepting *Asterias* proper and *Hemichemis*, which, according to Mr. Forbes, seems to be identical with his previously established *Luidia.* "His genus *Crossaster* also," says Mr. Forbes, "is my *Solaster*, published a year before. Several generic names, previously adopted by Agassiz and Nardo, are wantonly changed; thus *Uraster* is turned into *Asterocanthium*, and *Palmipes* into *Asteriscus*, with which he unites *Asterina.* In this paper Müller maintains that one of the five intermediate inferior plates of the *Ophiuridæ* bears a madreporiform tubercle, or rather corresponds to that body, a view which I am not inclined to adopt."

With regard to *Solaster*, we have seen how long ago Solastérie was used by De Blainville; but the practice of wantonly changing names is productive of so much confusion that it cannot be too strongly reprobated. Mr. Forbes admits, as all indeed must, that the generic characters in Müller's papers are excellently drawn up; and no difference of opinion can exist as to the great general value of the memoir.

The following arrangement is that of Dr. J. E. Gray, in the 'List of the Specimens of British Animals in the Collection of the British Museum.'

Centroniæ.

1. *Echinodermata.*

Class I. *Ditremata.*

Order I. *Echinida.*

Family 1. *Cidaridæ.*

I. *Cidaris.*

1. *C. papillata.* North Sea.

Family 2. *Echinidæ.*

I. *Echinus.*

1. *E. Flemingii.* Falmouth.
2. *E. esculentus* (*E. sphæra*, Forbes). Isle of Arran.
3. *E. miliaris.* Isle of Man.
4. *E. lividus.* Cork.

II. *Echinometra.*

1. *E. Drabachensis* (*E. neglectus*, Forbes). Shetland.

Family 3. *Scutellidæ.*

I. *Echinorachnius.*

1. *E. placenta.* Zetland.

II. *Echinocyamus.*

1. *E. pusillus.* Berwick-on-Tweed, and Arran.

Family 4. *Spatangidæ.*

I. *Spatangus.*

1. *S. purpureus.* Irish Sea.

II. *Echinocardium.*

1. *E. cordatus* (*Amphidotus cordatus*, Forbes). Coast of England.
2. *E. ovatum* (*Amphidotus roseus*, Forbes). Coast of Northumberland.

III. *Brissiopsis.*

1. *B. lyrifera* (*Brissus lyrifer*, Forbes). Shetland.

Order II. *Holothurida.*

Family 1. *Holothuridæ.*

I. *Thyone.*

1. *T. fusus* (*T. papillosa*, Forbes). Berwick Bay, Ireland.
2. *T. Raphanus.* Ireland.

II. *Holothuria.*

1. *H. nigra.* Cornwall.

Family 2. *Cuvieriadæ.*

I. *Psolus.*

1. *P. phantopus.* North Sea.

II. *Psolinus.*

1. *P. brevis.* Shetland.

Family 3. *Pentactidæ.*

I. *Pentacta.*

1. *P. frondosa* (*Cucumaria frondosa*, Forbes). Shetland.
2. *P. fusiformis* (*Cucumaria fusiformis*, Forbes). Shetland.
3. *P. Hyndmanni* (*Cucumaria Hyndmanni*, Forbes).
4. *P. lactea* (*Ocnus lacteus*, Forbes).
5. *P. pentactes* (*Cucumaria pentactes*, Forbes). South Coast of Devon.
6. *P. Montagui* (*Holothuria pentactes*, Forbes). South Devon.
7. *P. Neillii* (*Holothuria pentactes*, Forbes). Frith of Forth.
8. *P. dissimilis* (*Holothuria pentactes*, Forbes). Leith.

II. *Thyronidium.*

1. *T. pellucidum* (*Cucumaria hyalina*, Forbes). Shetland.
2. *T. Drummondi* (*Cucumaria Drummondii*, Forbes). South Devon, and Falmouth.

Family 4. *Synaptidæ.*

I. *Synapta.*

1. *S. inherens* (*Chirodota digitata*, Forbes). South Devon.
2. *S. Hensloviana.* May be the young of the preceding.

Family 5. *Sipunculidæ.*

I. *Sipunculus.*

1. *S. nudus* (*Syrinx nudus*, Forbes).
2. *S. papillosus* (*Syrinx papillosus*, Forbes). Clare, Ireland.
3. *S. macrorhynchopterus.*
4. *S. Harveii* (*Syrinx Harveii*, Forbes). Devonshire.
5. *S. Strombi* (*S. Bernhardus*, Forbes). Devonshire.
6. *S. Johnstoni* (*Sipunculus Johnstoni*, Forbes). Berwick.
7. *S. saccatus.* Teignmouth.
8. *S. tenuicinctus.* Ireland.
9. *S. Forbesii.* Ireland.
10. *S. granulosa.* Roundstone Bay.

II. *Phascolosoma.*

1. *P. Pallasii* (*Sipunculus Pallas*, Forbes). Coast of Sussex.

III. *Priapulus.*

1. *P. caudatus.*

IV. *Thalassema.*
 1. *T. rupium* (*T. Neptuni*, Forbes). South Coast of Devon.
V. *Echiurus.*
 1. *E. oxyurus* (*E. vulgaris*, Forbes). St. Andrews.
Class II. *Hypostoma.*
Order I. *Asteroida.*
Family 1. *Asteriadæ.*
I. *Asterias.*
 1. *A. rubens* (*Uraster rubens*, Forbes). Frith of Forth.
 2. *A. violaceus* (*Uraster violaceus*, Forbes). Frith of Forth, Plymouth Sound, Berwick-on-Tweed.
 3. *A. glacialis* (*Uraster glacialis*, Forbes). Plymouth Sound.
 4. *A. hispida* (*Uraster hispida*). Isle of Man.
Family 2. *Astropectenidæ.*
I. *Astropecten.*
 1. *A. irregularis* (*Asterias aurantiaca*, Forbes). South Coast of England.
II. *Luidia.*
 1. *L. Savignii* (*L. fragilissima*, Forbes). Isles of Man and Arran.
III. *Solaster.*
 1. *S. endeca.* Scotland.
 2. *S. papposa.* Frith of Forth.
IV. *Henricia.*
 1. *H. oculatus* (*Cribella oculata*, Forbes). Plymouth Sound, Coast of Northumberland, Frith of Forth.
 2. *H. rosea* (*Cribella rosea*, Forbes). Ayrshire.
Family 3. *Pentacerotidæ.*
I. *Hippasteria.*
 1. *H. equestris* (*Goniaster equestris*, Forbes). North of England.
 2. *H. abbensis* (*Goniaster abbensis*, Forbes). St. Abb's Head.
Family 4. *Asterinidæ.*
I. *Palmipes.*
 1. *P. membranaceus.* Isle of Man.
II. *Porania.*
 1. *P. pulvillus* (*Goniaster Templetoni*, Forbes). Plymouth Sound, Arran, Isle of Man.
III. *Asterina.*
 1. *A. gibbosa.* Plymouth Sound.
Order II. *Ophiurida.*
Family 1. *Ophiuridæ.*
I. *Ophiolepis.*
 1. *O. ciliata* (*Ophiura texturata*, Forbes). Dover, Frith of Forth.
 2. *O. albida* (*Ophiura albida*, Forbes). Frith of Forth.
 3. *O. elegans* (*Ophiocoma neglecta*, Forbes). Shetland.
 4. *O. punctata* (*Ophiocoma punctata*, Forbes). Scotland.
 5. *O. filiformis* (*Ophiocoma filiformis*, Forbes). Frith of Clyde, Frith of Forth.
II. *Ophiopholis.*
 1. *O. aculeata* (*Ophiocoma bellis*, Forbes). Isle of Man, Shetland, and Orkney.
 2. *O. brachiata* (*Ophiocoma brachiata*, Forbes). Devonshire.
 3. *O. Ballii* (*Ophiocoma Ballii*, Forbes). Ireland.
 4. *O. Goodsiri* (*Ophiocoma Goodsiri*, Forbes). North Britain.
III. *Ophiocoma.*
 1. *O. nigra* (*O. granulata*, Forbes). Devon, Plymouth Sound.
IV. *Ophiothrex.*
 1. *O. fragilis* (*Ophiocoma rosula*, Forbes). Torbay.
 2. *O. minuta.* Isle of Man.
Family 2. *Astrophytonidæ.*
I. *Astrophyton.*
 1. *A. arborescens* (*A. scutatum*, Forbes). North Sea.
Order III. *Crinoidea.*
Family 1. *Pentacrinidæ.*
I. *Antedon.*
 1. *A. decameros* (*Comatula rosacea*, Forbes). British Ocean, Cork, Plymouth Sound.
II. *Gynameda.*
 1. *G. pulchella.* Kent.

Of this arrangement Mr. Forbes says:—"The other memoir to which I must allude is one by Mr. Gray on the Star-Fishes, which he calls the class *Hypostoma*, and defines somewhat ambiguously, published simultaneously with my two first numbers, in the 'Annals of Natural History.' I am afraid I must censure Mr. Gray for changing names still more than Müller, and with less reason. It is a pity zoologists do not take a lesson from their fellow-labourers in the field of nature, the botanists, in this respect. Mr. Gray has increased the confusion by giving fragments of descriptions instead of genuine and specific characters, probably from carrying too far a laudable desire for brevity. His essay deserves praise however for recording many new foreign habitats of the beautiful animals he catalogues." Dr. Gray's arrangement was first published in the 'Annals of Natural History' in 1840.

The following is Professor E. Forbes's arrangement of the *Echinodermata*, to which we have added his table of the distribution of the British species:—

Order I. *Pinnigrada.*

Crinoideæ.—First appearance of cirrhi springing from brachial membranes, which with the true arms form the organs of motion.

II. *Spinigrada.*

Ophiuridæ.—Disappearance of brachial membranes; cirrhi as before; true arms clothed with spines for motion.

III. *Cirrhigrada.*

Asteriadæ.—Arms disappear; body more or less lobed, and lobes channeled beneath for cirrhi, which act as suckers, and are the organs of motion.

IV. *Cirrhi-Spinigrada.*

Echinidæ.—Gradual disappearance of lobes; cirrhiferous canals appearing as avenues where cirrhi act as in Order III., but are assisted by mobile spines clothing the integument.

V. *Cirrhi-Vermigrada.*

Holothuriadæ.—Lobes disappear; motions effected by avenues of cirrhi, assisted by contraction and extension of the soft body.

VI. *Vermigrada.*

Sipunculidæ.—Cirrhi become obsolete and disappear; motion effected by the contraction and extension of the animal's body.

"A glance," says Mr. Forbes, "at this arrangement will at once show that it is most natural. There is nothing novel in it as regards the constitution of the groups, saving the recognition of the *Ophiuridæ* as an order equivalent to the other orders; but as an explanation of the true nature and relation of the Echinodermatous tribes I prefer it to any arrangement at present used, and have accordingly followed it throughout this work. All the *Radiata* are greatly influenced in the arrangement of their parts by some definite number. In the *Echinodermata* the reigning number is five. The name of 'Five-Fingers' commonly applied by mariners to the Star-Fishes is founded on a popular recognition of the number regnant. It has long been noticed. Among the problems proposed by that true spirited but eccentric philosopher Sir Thomas Browne is one—'Why among the Sea-Stars nature chiefly delighteth in five points?' and in his 'Garden of Cyrus' he observes, 'By the same number (five) doth nature divide the circle of the Sea-Star, and in that order and number disposeth those elegant semicircles or dental sockets and eggs in the Sea-Hedgehog.' Among the lower and the typical orders we find this number regulating the number of parts. Every plate of the Sea-Urchin is built up of pentagonal particles. The skeletons of the digestive, the aquiferous, and the tegumentary systems equally present the quinary arrangement; and even the cartilaginous framework of the disc of every sucker is regulated by this mystic number. When the parts of Echinoderms deviate from it, it is always either in consequence of the abortion of certain organs, or it is a variation by representation; that is to say, by the assumption of the regnant number of another class. Thus do monstrous Star-Fishes and Urchins often appear quadrate and have their parts four-fold, assuming the reigning number of the *Actinodermata* consistent with a law in which I put firm trust, that when parallel groups vary numerically by representation, they vary by interchange of their respective numbers.

"In this short introduction I have rather given the generalities of the subject than details of structure, for which I would refer the reader to the excellent account of the anatomy of *Echinodermata* given by Professor Jones in his 'Outlines of the Animal Kingdom.' I shall conclude by presenting a tabular view of the distribution of our native species. In the first of the two following tables the numbers of species of each family known to inhabit the several zones of the sea is given; in the second a view of their distribution in the various provinces of the British seas with such foreign localities as are recorded. I have divided the marine provinces thus:—

"I. Thulean, including the Orkney and Shetland Islands. II. Hebridean. III. Scottish Eastern Coast. IV. English Eastern Coast. V. English Channel. VI. St. George's Channel. VII. Southern, the District between Land's End and Cape Clear. VIII. South-west, Irish. IX. North-west, Irish. X. The Clyde Province and North Channel. XI. Irish Sea.

"*Table of Zonal Distribution.*

Zones of the Sea.	*Crinoideæ.*	*Ophiuridæ.*	*Asteriadæ.*	*Echinidæ.*	*Holothuriadæ.*	*Sipunculidæ.*	Total.
Littoral	0	4	6	3	1	2	16
Laminarian . . .	1	5	6	4	5	6	27
Coralline	1	9	11	7	12	2	42
Deep-Sea Coral . .	0	3	3	3	(?)	(?)	9

"*Table of the Geographical Distribution of the British Species of Echinodermata.*

Genera and Species.	British Distribution.	Gen. Distribution.
Pinnigrada.		
I. *Comatula,* Lam. .		
1. *C. rosacea,* Link. .	I. II. VI. VII. X. XI.	Scandinav., Medit.
Spinigrada.		
II. *Ophiura,* Lam. . .		
1. *O. texturata,* Lam.	I. XI.	Scand., Celt. Medit.
2. *O. albida,* Forbes .	I. XI.	North Sea.
III. *Ophiocoma,* Agas. .		
1. *O. neglecta,* Johnst.	I. III. VI. VIII. XI.	
2. *O. Ballii,* Thomp. .	VI.	
3. *O. punctata,* Forbes	III.	
4. *O. filiformis,* Mul.	VIII. X.	Norway.
5. *O. brachiata,* Mont.	V. X.	
6. *O. granulata,* Link.	I. V. VI. XI.	Scandinavia.
7. *O. bellis,* Link. . .		
8. *O. Goodsiri,* Forbes	I. III.	
9. *O. rosula,* Link. .	I. XI.	
10. *O. minuta,* Forbes	VII. XI.	
IV. *Astrophyton,* Link.		
1. *A. scutatum,* Link.	I. VII.	
Cirrhigrada.		
V. *Uraster,* Agassiz .		
1. *U. glacialis,* Lin. .	II. VII. VIII. X. XI.	
2. *U. rubens,* Lin. .	I. XI.	
3. *U. violacea,* Mul. .	I. IV. VI. VII. X. XI.	
4. *U. hispida,* Pen. .	II. III. X. XI.	
VI. *Cribella,* Agas. .		
1. *C. oculata,* Pen. .	I. IV. VI. VII. X. XI.	Norway (?), West of France.
2. *C. rosea,* Mul. . .	VII. X.	
VII. *Solaster,* Forbes .		
1. *S. endeca,* Lin. .	I. III. IV. VI. VII. XI.	Scandinavia.
2. *S. papposa,* Lin. .	I.—XI.	Scand. and Celtic Seas, Medit. (?), Asia (?).
VIII. *Palmipes,* Link. .		
1. *P. membranaceus,* Retz	IV. VII. X. XI.	Arctic Scand. and Medit. Seas.
IX. *Asterina,* Nardo .		
1. *A. gibbosa,* Pen. .	II. V. XI.	Celt. and Med. Seas.
X. *Goniaster,* Agas. .		
1. *A. Templetoni,* Thomp. . . .	IV. VII. X. XI.	
2. *A. equestris,* Gmel.	III. IV. VII.	North Sea.
XI. *Asterias,* Lin. . .		
1. *A. aurantiaca,* Lin.	I. III. XI.	All the Europ. Seas.
XII. *Luidia,* Forbes . .		
1. *L. fragilissima,* Forbes . .	I. III. IV. VII. VIII. XI.	
Cirrhi-Spinigrada.		
XIII. *Cidaris,* Leske . .		
1. *C. papillata,* Flem.	I.	Norway.
XIV. *Echinus,* Lin. . .		
1. *E. sphæra,* Mul. .	I. XI.	Arctic, Northern, and Celtic Seas.
2. *E. miliaris,* Leske	I. VII. X. XI.	
3. *E. Flemingii,* Ball	I. VII.	
4. *E. lividus,* Lam. .	VIII. IX.	Med., Portugal (?), West of France.
5. *E. neglectus,* Lam.	I.	
XV. *Echinocyamus,* Leske . .		
1. *E. pusillus,* Mul. .	I. XI.	Norway, West of France.
XVI. *Echinarachnius,* Leske		
1. *E. placenta,* Gmel.	I.	Canada, Asia (?).
XVII. *Spatangus,* Klein .		
1. *S. purpureus,* Mul.	I. III. IV. VI. XI.	Scand., Medit.
XVIII. *Brissus,* Klein . .		
1. *B. lyrifer,* Forbes .	X.	
XIX. *Amphidotus,* Agas.		
1. *A. cordatus,* Pen. .	I.—XI.	Northern Seas.
2. *A. roseus,* Forbes .	I. III. VI. X. XI.	
Cirrhi-Vermigrada.		
XX. *Psolus,* Oken . .		
1. *P. phantapus,* Lin.	I. III. V. X. XI.	Norway.
XXI. *Psolinus,* Forbes .		
1. *P. brevis,* F. & G. .	I. X.	
XXII. *Cucumaria,* Blainv.		
1. *C. frondosa,* Gmel.	I. III.	Norway.
2. *C. pentactes,* Mul. .	III.—V. X.	North. & Celt. Seas.
3. *C. communis,* F. & G.	III. VII. X.	
4. *C. fusiformis,* F. & G.	I.	
5. *C. hyalina,* Forbes.	I.	
6. *C. Drummondii,* Thomp. . .	X.	

Table Continued.

Genera and Species.	British Distribution.	Gen. Distribution.
7. *C. Hyndmanni,* Thomp. . .	VIII. X.	
8. *C. fucicola,* F. & G.	I.	
XXIII. *Ocnus,* F. & G. .		
1. *O. brunneus,* Forbes	III. X. XI.	
2. *O. lacteus,* F. & G.	I. III. X.	
XXIV. *Thyone,* Oken . .		
1. *T. papillosa,* Mul. .	I. III. VIII. X. XI.	Norway.
2. *T. Portlockii,* Forb.	X.	
XXV. *Chirodota,* Esch. .		
1. *C. digitata,* Mont. .	V.	
Vermigrada.		
XXVI. *Syrinx,* Bohadsch. .		
1. *S. nudus,* Lin. . .	IV. V. VII.	Celt. Seas, Medit.
2. *S. papillosus,* Thomp	VIII. XI.	West Indies.
3. *S. Harveii,* Forbes.	V.	
XXVII. *Sipunculus,* Lin. .		
1. *S. Bernhardus,* Forbes. . .	I. XI.	Norway, France.
2. *S. Johnstoni,* Forbes	III. V. (?)	
XXVIII. *Priapulus,* Lam. .		
1. *P. caudatus,* Lam. .	I. III. IV. X.	Arct. & Scand. Seas.
XXIX. *Thalassema,* Cuv. .		
1. *T. Neptuni,* Gærtner	IV.	
XXX. *Echiurus,* Cuv. .		
1. *E. vulgaris,* Savig.	III.	Belgic Coast."

Fossil Echinodermata.

Till within a comparatively recent period but little attention was paid to the study of the fossil *Echinodermata.* Various forms of *Encrinites* [ENCRINITES] had been described, and the forms of *Echinidæ,* especially those presented by the Chalk, had been studied and described; but through the labours of Wahlenberg, Von Buch, E. Forbes, and others, a new family of animals, the *Cystideæ,* have been added to the group of *Echinodermata,* and large additions have been made to our knowledge of other forms. Previous to referring to more recent researches, we present a list of the fossil *Echinodermata,* as given in Professor Tennant's List of British Fossils.

TERTIARY SERIES.

Crag Formation.

Echinocyamus Suffolciensis, Ag.
Echinus ——(?).
Spatangus ——(?).
Asterias ——(?).
Amphidetus ——(?).
Temnopleurus ——(?).

London Clay.

Glypticus ——(?), *Ophiura Wetherellii,* Morr. M.S.S.
Pentacrinus Sowerbii, Sow.
Spatangus ——(?).

Remains of this family belonging to two or three genera have been found at Sheppey, but are not yet described.

Cretaceous Group.

Ananchytes conoideus, Godf.
A. hemisphæricus, Brong.
A. ovatus, Lam.
A. striatus, Lam.
Apiocrinus ellipticus, Mill.
Arbacia granulosa, Goldf.
Caratomus hemisphæricus, Des.
C. rostratus, Ag.
Cidaris claviger, König.
C. cretosa, Park.
C. marginata, Goldf.
Cassidulus lapis-cancri, Lam.
Catopygus carinatus, Ag.
Cidaris saxatilis, Park.
C. vesiculosa, Goldf.
Comptonia elegans, Gray.
Diadema granulosum, Ag.
D. variolare, Ag.
Discoidea cylindrica, Ag.
D. hemisphærica, Ag.
D. subuculus, Bronn.
Galerites abbreviatus, Goldf.
G. albogalerus, Lam.
G. conicus, Ag.
G. vulgaris, Lam.
G. subrotundus, Ag.
Goniophorus lunulatus, Ag.
Glenotremites paradoxus, Goldf.
Holaster complanatus, Ag.
H. granulosus, Goldf.
H. nodulosus, Goldf.
H. subglobosus, Goldf.
Marsupites Milleri, Mant.
Micraster Bufo, Ag.
M. cor-anguinum, Brong.
M. cor-testudinarium, Goldf.
M. lacunosus, Park.
M. Murchisonii, König.
M. prunella, Lam.
M. rostratus, Mant.
Nucleolites lacunosus, Goldf.
Ophiura serrata, Römer.
Pyrina depressa, Desm.
Salenia petalifera, Ag.
S. geometrica, Ag.
S. scutigera, Gray.
S. stellulata, Ag.
Spatangus ornatus, Defr.
Tosia lunata, Woodw.
T. regularis, Park.

Oolitic Group.

Amphiura Prattii, Forbes.
Apiocrinus Prattii, Gray.
A. rotundus, Mill.
Aspidura loricata, Ag.
Asterias Cotteswoldiæ, Buckm.
Cidaris Blumenbachii, Goldf.
C. coronata, Goldf.
C. crenularis, Lam.
C. elegans, Goldf.
C. glandifera, Goldf.

Oolitic Group. *Continued.*

C. gracilis, Benson.	*E. perlatus*, Desm.
C. marima, Goldf.	*Nucleolites clunicularis.*
C. monilipora, Phil.	*N. dimidiatus.*
C. propinquus, Goldf.	*Ophioderma Egertoni*, Forbes.
C. subangularis, Goldf.	(*Ophiura*, Brod.)
Clypeus emarginatus, Phil.	*O. Milleri*, Forbes.
C. orbicularis, Phil.	(*Ophiura*, Phil.)
C. ornatus, Buckm.	*O. tenuibrachiata*, Forbes.
C. patella, Ag.	*Ophiura Murravii*, Forbes.
C. sinuatus, Park.	*Pentacrinus basaltiformis*, Mill.
Diadema Bechei, Ag.	*P. Briareus*, Mill.
D. priscum, Ag.	*P. scalaris*, Goldf.
D. vagans, Phil.	*P. subangularis*, Mill.
Disaster ovalis, Ag.	*P. vulgaris*, Schlot.
Discoidea depressa, Ag.	*Pygaster pelalliformis*, Ag.
Echinolampas pentagonalis, Phil.	*P. semisulcatus*, Phil.
Echinus germinans, Phil.	

Carboniferous Group.

Actinocrinus aculeatus, Aust.	*P. Derbiensis*, Sow.
A. amphora, Gilb.	*P. globosus*, Say.
A. cataphractus, Aust.	*P. inflatus*, Sow.
A. constrictus, M'Coy.	*P. oblongus*, Sow.
A. costus, M'Coy.	*P. orbicularis*, Sow.
A. globosus, Phil.	*P. pentagonalis*, Sow.
A. lævis, Mill.	*Phillipsocrinus caryocrinoides*, M'Coy.
A. pusillus, M'Coy.	*Platycrinus antheliontes*, Aust.
A. tessellatus, Phil.	*P. contractus*, Phil.
A. triacontadactylus, Mill.	*P. coronatus*, Godf.
Atocrinus Milleri, M'Coy.	*P. ellipticus*, Phil.
Cyathocrinus bursa, Phil.	*P. elongatus*, Phil.
C. calcaratus, Phil.	*P. expansus*, M'Coy.
C. conicus, Phil.	*P. gigas*, Phil.
C. distortus, Phil.	*P. laciniatus*, Phil.
C. inequidactylus.	*P. lævis*, Mill.
C. macrocheirus, M'Coy.	*P. microstylus*, Phil.
C. mammillaris, Phil.	*P. ornatus*, M'Coy.
C. ornatus, Phil.	*P. punctatus*, M'Coy.
C. planus, Mill.	*P. rugosus*, Mill.
Echinocrinus Benburbensis, Port. sp.	*P. similis*, M'Coy.
E. glabrispina, Phil. sp.	*P. triacontadactylus*, M'Coy.
E. Munsterianus, De Koninch.	*P. tuberculatus*, Mill.
E. Urii, Flem. sp.	*Poteriocrinus conicus*, Phil.
E. vetustus, Phil. sp.	*P. crassus*, Mill.
Euryocrinus concavus, Phil.	*P. gracilis*, M'Coy.
Gilbertsocrinus bursa, Phil.	*P. impressus*, Phil.
G. calcaratus, Phil.	*P. tenuis*, Mill.
G. mammillaris, Phil.	*Rhodocrinus abnormis*, M'Coy.
G. simplex, Portl.	*R. verus*, Mill.
Palæchinus elegans, M'Coy.	*Symbathocrinus conicus*, Phil.
P. ellipticus, Scouler.	*Taxocrinus Egertoni*, Phil.
P. gigas, M'Coy.	*T. granulosus.*
P. Konigii, M'Coy.	*T. nobilis.*
P. sphæricus, Scouler.	*T. polydactylus*, M'Coy.
Pentatrematites acutus, Sow.	
P. angulatus, Sow.	

Devonian Group.

Adelocrinus hystrix, Phil.	*C. pinnatus*, Goldf.
Cyathocrinus distans, Phil.	*C. variabilis*, Phil.
C. ellipticus, Phil.	*Pentatrematites ovalis*, Goldf.
C. geometricus, Goldf.	*Platycrinus interscapularis*, Phil.
C. macrodactylus, Phil.	*P. pentangularis*, Mill.
C. megastylus, Phil.	*Taxocrinus macrodactylus*, Phil.
C. nodulosus, Phil.	

Silurian Group.

Actinocrinus arthriticus, Phil.	*Dimerocrinus decadactylus*, Phil.
A. moniliformis, Mill.	*D. icosidactylus*, Phil.
A. retiarius, Phil.	*Echinosphærites granulatus*, M'Coy.
A. simplex, Phil.	*Rhodocrinus quinquangularis*, Mill.
Cyathocrinus capillaris, Phil.	*Sagenocrinus expansus*, Aust.
C. rugosus, Mill.	*Taxocrinus tuberculatus*, Phil.
C. goniodactylus, Phil.	*Trochocrinus lævis*, Portl.
C. pyriformis, Phil.	

But few of the species here recorded belong to the group of the true Star-Fishes, or *Asteriadæ*. To Professor E. Forbes we are indebted for having collected together all the information possessed on this subject. In his paper in the 'Memoirs of the Geological Survey of Great Britain, on the British Fossil Asteriadæ,' he says—

"The traces of the first appearance of *Asteriadæ* occur in rocks of the Bala series, or even lower in the geological scale. They were first noticed by Professor Sedgwick, who found them in beds of corresponding age in Cumberland, where they were also observed by Mr. Daniel Sharpe. The researches of the Geological Survey have brought to light similar fossils in the Bala Rocks, near Bala, and in the ashy slates at Drumcannon, near Waterford, where they were found by Captain James. These latter beds probably correspond with the former. It is very remarkable that forms of Star-Fishes, strikingly similar, have been found in the Lower Silurian Strata of the United States.

"The Cumberland, Welsh, and Irish Star-Fishes all belong to one genus. After a very careful examination of all the specimens I have been able to procure (and through the kindness of Professor Sedgwick and Mr. Sharpe every facility has been afforded), I am induced to refer them to the existing genus *Uraster* (*Asteracanthion* of Müller and Troschel), members of which are at the present day the most abundant Star-Fishes in the British seas and throughout North America.

"The general aspect of the Palæozoic Star-Fishes must have been strikingly similar to that of the *Urasteriæ*, now living.

"Indeed, impressions taken from the latter in clay would so closely resemble those which we find in ancient rocks, that the critical eye of a naturalist would be required for the definition of their specific distinctness. Nor does this arise through the obscurity of imperfections of such impressions, for the external characters, so far as colour and sculpture of surface, and even many points of structure, are very completely indicated in them, rude as they may seem.

"As yet, with the exception of the instances already referred to, only one other instance of the discovery of a Palæozoic Asteriad has come to my knowledge, namely, that of a well-preserved species, apparently also belonging to the genus *Uraster*, by M. Thorent, in the 'Terrains Anthraxifères' of the department of l'Aisne. It is probable, however, that the progress of research will bring many more to light. In the older secondary strata not a few have been found, both in Britain and abroad. A doubtful form (*Asterias obtusa*) has been figured by Goldfuss from the Muschelkalk, who has also made known a true *Asterias* or *Astropecten*, from the Lias of Wurtemberg. Several species of *Astropecten* have been observed in the Oolites of Yorkshire, and similar forms in corresponding beds in Germany. Where *Urasteriæ* have also been found, a single example of fossil *Luidia* has been made known from the marlstone of Yorkshire, and a *Goniaster* from Oolitic Beds in Germany. In the Upper Secondary (Cretaceous Rocks) numerous fossil Star-Fishes have occurred, especially of the genus *Goniaster*. Representatives of *Oreaster*, *Astropecten*, *Asterina*, and *Arthraster* (n. g.), are also present in the Cretaceous series. The few older Tertiary Star-Fishes with which we are acquainted belong to the genus *Astropecten*. Arguing from the analogy of their associates, there can be no question that Star-Fishes were abundant in the Tertiary seas.

"Yet how very rare are the traces of their existence. In the later Tertiary Strata, the only evidence as yet procured of their presence during the deposition of those beds consists in a few minute fragmentary ossicula of *Urasteria*. Yet when we consider the gregarious habits of those Star-Fishes, especially of the species to which the ossicula preserved in all probability belonged, it is very wonderful to remark the almost total disappearance of their exuviæ, and the fact should serve as a caution to those who would unhesitatingly infer the absence of a tribe of organised beings, especially of such as present few facilities for preservation, from the absence of their fossil remains. Even now, when dredging, we very rarely bring up any remains of dead Star-Fishes, whilst the living animals are not only present in the locality explored, but often so abundant as to fill the bag of the dredge, to the exclusion of all other creatures.

"Instead of confining this paper to an account of the Palæozoic Star-Fishes only, I have thought it desirable to embody in it a synopsis of all our British fossil species, and a notice of all foreign ones with which I am acquainted. This is the more necessary as no connected account of the fossil *Asteriadæ* exists, and as the geologist has no text at present by which he may determine the species in his collection." (See Table in column 485.)

One of the most interesting groups of Fossil *Echinodermata*, is undoubtedly that to which the name *Cystideæ* has been given. Remains of these creatures were known to occur in the strata of the north of Europe, as long ago as the time of Linnæus. The true nature and relations of these fossils were entirely misunderstood, till the appearance of Von Buch's illustrated Essay 'Über Cystideen,' published in 1845. Since the publication of Von Buch's Essay numerous researches have been made in this country and on the continent of Europe on this subject. One of the most valuable contributions is the Monograph of Professor E. Forbes, 'On the Cystideæ of the Silurian Rocks of the British Islands,' in the 'Memoirs of the Geological Survey of Great Britain.' The general characters of this group of animals are as follows:—They are more or less spherical bodies covered with polygonal plates, varying in number according to the genus, closely fitting together, so as to invest the entire surface with a coat of mail, except at four points, namely, inferiorly where the body unites with a stem; centrally or above the centre; on one side, where there is an opening closed by valves, supposed with good reason to be the orifice of the reproductive system; and superiorly where the mouth is found, usually if not always with a small perforation, supposed to be a vent, alongside of it. These parts, namely, the plates investing the body, the three orifices (for the fourth perforation, that of the base, is continuous with the canal of the stem where the latter is well developed), and probably the stem, are common to all *Cystideæ*.

There are other parts, apparently of great consequence in the organisation of the animal, which are common only to certain members of the order. These are the brachial appendages (arms and tentacula) and certain curious organs connected with the plates, to which the name of 'pectinated rhombs' may he appropriately given. (Forbes.)

The result of Professor E. Forbes's lahours are given in the following Tahle of Fossil *Asteridæ* :—

	Genus.	Species.	Formation.	Locality.	Reference.
Palæozoic.	*Uraster*	*obtusus*, n. s.	Lower Silurian	Ireland, N. Wales	
	Uraster	*primævus*, n. s.	Lower Silurian	Westmor.	
	Uraster	*Ruthveni*, n. s.	Lower Silurian	Westmor.	
	Uraster	*hirudo*, n. s.	Lower Silurian	Westmor.	
	Uraster (?)	*matutina*, Hall	Lower Silurian	United St.	Hall, Pal., N.Y.
	Uraster (?)	*antiqua*, Locke	Lower Silurian	United St.	Proc. Ac. N. S. Phil., vol. iii.
	Uraster (?)	*antiqua*, Troost	Lower Silur. (?)	United St.	Tr. Geol. Soc. Pen., vol. i.
	Uraster	'Five other sp.,' Troost	Lower Silur. (?)	United St.	Ditto
	Uraster	*constellata*, Thor.	Terrains anthraxifères	N. of Fran.	Tr. Geol. Soc. vol. iii.
Lower Secondary.	*Uraster*	*lumbricalis*, Gold.	Terrains anthraxifères	Germany	Petrif. Germ.
	Uraster	*lanceolata*, Goldf.	Terrains anthraxifères	Germany	Petrif. Germ.
	Goniaster	*Jurensis*, Goldf.	Terrains anthraxifères	Wurtemb.	Petrif. Germ.
	Astropecten	*arenicolus*, Gold.	Marlstone	Yorksh. Germa.	Petrif. Germ. Charlesw. Jour.
	Astropecten	*Hastingiæ*, n. s.	Marlstone	Yorkshire	
	Astropecten	*Cotteswoldeæ*, Buckman			
	Astropecten	*Orion*, n. s.	Marlstone	Yorkshire	
	Astropecten	*Phillipsii*, n. s.	Marlstone	Yorkshire	
	Astropecten	*Mandelshohi*, Munster	Oolites	Aalen	Munst. Beitr. 1st Heft.
	Astropecten	*Prevus*, Goldfuss	Lias	Wurtemb.	
	Luidia	*Murchisonii*, Williamson	Marlstone	Yorkshire	Mag. N. Hist.
Upper Secondary.	*Arthraster*	*Dixoni*, n. s.	White Chalk	S. of Engl.	Dixon
	Oreaster	*coronatus*, n. s.	White Chalk	S. of Engl.	Dixon
	Oreaster	*squamatus*, n. s.	White Chalk	S. of Engl.	Dixon
	Oreaster	*Boysii*, n. s.	White Chalk	S. of Engl.	Dixon
	Oreaster	*bulbiferus*, n. s.	White Chalk	S. of Engl.	Dixon
	Oreaster	*obtusus*, n. s.	White Chalk	S. of Engl.	Dixon
	Oreaster	*ocellatus*, n. s.	White Chalk	S. of Engl.	Dixon
	Goniaster	*Hunteri*	White Chalk	S. of Engl.	Mantell, Medals
	Goniaster	*rugatus*, n. s.	White Chalk	S. of Engl.	Dixon
	Goniaster	*uncatus*, n. s.	White Chalk	S. of Engl.	Dixon
	Goniaster	*sublunatus*	White Chalk	S. of Engl.	Dixon
	Goniaster	*Parkinsoni*	White Chalk	S. of Engl.	Parkinson
	Goniaster	*Mantelli*	White Chalk	S. of Engl.	
	Goniaster	*Bowerbankii*, n. s.	White Chalk	S. of Engl.	Dixon
	Goniaster	*lunatus*, Woodw.	White Chalk	S. of Engl.	Woodward, Geol., Norfolk
	Goniaster	*Coombii*, n. s.	White Chalk	S. of Engl.	Dixon
	Goniaster	*angustatus*, n. s.	White Chalk	S. of Engl.	Dixon
	Goniaster	*latus*, n. s.	White Chalk	S. of Engl.	Dixon
	Goniaster	*Smithii*, n. s.	White Chalk	S. of Engl.	Dixon
	Goniaster	*mosaicus*, n. s.	Chalk Marl	S. of Engl.	Dixon
	Goniaster	*elegans*, Gray	Green Sand	Blackdow.	Dixon
	Goniaster	*Comptoni*, n. s.	Green Sand	Blackdow.	Dixon
	Goniaster	*Schultzii*, Römer.	Quader	Germany	Römer, Tor.
	Palmipes	*antiquus*, Hising	Green Sand	Sweden	Leth. Suecica
	Astropecten	*propinquus*, Phil.	Green Sand	Germany	Phili. Beitr.
	(Doubtful sp. or repetitions)				
	Goniaster	*quinqueloba*, Gol.	White Chalk	Germ. &c.	Potr, Germ.
	Goniaster	*Couloni*, Agassiz.	Chalk Marl (?)	Neuchatel	Neuf. Mem. i.
	Goniaster	*porosus*, Agassiz.	Chalk Marl (?)	Neuchatel	Neuf. Mem. i.
	Goniaster (?)	*stratifera*, Desm.	Chalk	France	Bord., Tr. t. v.
	Goniaster (?)	*chilipora*, Desm.	Chalk	France	Bord., Tr. t. v.
	Goniaster	*punctulata*, Des.	Chalk	France	Bord., Tr. t. v.
	Uraster	*rubens*, Linn. (?)	Crag	Suffolk	S. Wood
Tertiary.	*Goniaster*	*Stokesii*, n. s.	London Clay	Sheppey	
	Goniaster	*marginatus*, n. s.	London Clay	Sheppey	
	Astropecten	*crispatus*, n. s.	London Clay	Sheppey	
	Astropecten	*armatus*, n. s.	London Clay	Sheppey	
	Doubtful sp.				
	Astropecten	*poritoides*, Des.	Tertiaries	S. of Fran.	Bord. Tr. t. v.
	Astropecten	*lævis*, Desm.	Tertiaries	S. of Fran.	Bord. Tr. t. v.
	Astropecten	*Adriatica*, Des.	Tertiaries	S. of Fran.	Bord. Tr. t. v.

The following is an arrangement of the genera of British *Cystideæ* found in the Silurian Rocks :—

A. Bodies composed of definite numbers of plates.

a. With arms and pectinated rhombs. (Upper Silurian.)

Pseudocrinites.

Apiocystites.

b. Armless, with oval tentaculated and pectinated rhombs. (Upper Silurian.)

Prunocystites.)

c. Armless, with oral tentacula wanted; pectinated rhomb present. (Upper Silurian.)

Echino-Encrinus.

d. Armless, no rhombs; bodies composed of four series of plates, exclusive of the oral plates. (Lower Silurian.)

Hemicosmites.

e. Armless, no rhombs; bodies composed of more than four series of plates, exclusive of the oral plates. (Lower Silurian.)

Caryocystites.

B. Bodies composed of an indefinite number of plates.

a. With arms, no rhombs. (Lower Silurian.)

Agelocrinites.

b. Without arms, no rhombs. (Lower Silurian.)

Various views have been entertained hy naturalists as to the nature of these bodies. Linnæus, from the polygonal forms of the plates with which they are covered, regarded them as minerals. From the time however that their animal nature was admitted, they have heen regarded hy most writers as helonging to various groups of the *Echinodermata*. Mr. M'Coy has suggested their resemhlance to certain forms of *Ascidia*, hut Professor E. Forhes regards this resemhlance as one of analogy only. In the Monograph above referred to, Professor Forhes thus arranges the *Cystideæ* amongst the *Echinodermata* :—

ECHINIDÆ. ASTERIADÆ. OPHIURIDÆ.

	CYSTIDEÆ	
Archæocidaris.		
Palæchinus.		*Pentacrinites.*
Agelocrinites.		Apiocystites.
		Pseudocriuites.
Sphœronites.		Pruuocystites.
		Echinoencrinites.
Caryocystites.		Cryptocrinites.

Hæmicosmites.

Caryocrinus.

CRINOIDEÆ.

"In this diagram," says Professor Forhes, "the word CYSTIDEÆ occupies the centre, and around it are the names of the several geuera of undouhted Cystideans printed in small Roman letters, and arranged in the order of their affinities. Between them, however, and the names in small Roman capitals indicating the great groups of equal value with the CYSTIDEÆ, are other names of genera printed in italics. These are the genera which seem to me to link the Cystideans with the members of the other great sectious of *Echinodermata.* The lowest of these is the remarkable fossil *Caryocrinus*, admitted on all hands to afford a distinct passage from the Crinoids to the Cystideans, as far as there can be a distinct passage hetween two great orders." He then proceeds to point out in detail the relations of the various genera referred to with each other and with the families at the top of the diagram.

ECHINODI'SCUS. [ECHINIDÆ.]

ECHINOLA'MPAS, a genus of fossil *Echinida*, from the Oolitic and Chalk Strata. [ECHINODERMATA.]

ECHINOME'TRA. [ECHINIDÆ.]

ECHINONE'US. [ECHINIDÆ.]

ECHINO'PHORA (from ἐχῖνος, a hedgehog, and φορος, in composition signifying 'hearing'), a genus of Plants helonging to the natural order *Umbelliferæ*, and to the tribe *Smyrneæ*. It has a calyx of fivo teeth, the petals obcordate with an inflexed point, the exterior largo and hifid; the flowers of the ray sterile on loug stalks, the central fertile and solitary; the fruit ovate terete, emhedded in the enlarged receptacle; the carpels with five depressed equal striated wavy ridges; interstices with single vitta, covered by a cobweh-like memhrane. The *E. spinosa*, the Sea-Parsnip, has heen admitted into the British Flora, but it must he considered a douhtful native. It has heen found in Lancashire and Kent. It is mostly an inhahitant of sandy sea-shores, and has pinnate spinose leaves, and resembles in hahit and external character the *Eryngium*. Three other species are described. When cultivated they require a warm situation and a dry soil. They must he propagated hy cuttings of the roots or stems. (Don, *Dichlamydeous Plants.*)

ECHINORHI'NUS. [SQUALIDÆ.]

ECHINORO'DON. [ECHINIDÆ.]

ECHINO'STACHYS, a genus of Fossil Plants, from the Bunter Sandsteiu. (Brongniart.)

ECHINUS. [ECHINIDÆ.]

ECHIODON, a genus of Apodal Malacopterygious Fishes belonging to the family *Murænidæ*. The head is oval; jaws furnished with large cylindrical teeth in frout; other smaller teeth on the palatal hones and on the vomer. Gill-apertures large; branchiostegous memhrane with seven rays. Body smooth, without scales, elongated, compressed. Dorsal and anal fins nearly as long as the body; all the rays soft; no ventral fins; anal aperture near the head.

This genus was constituted to receive a very remarkable fish found by Dr. J. L. Drummond on the beach at Camclough, near Glenarm, in the county of Antrim, Ireland. It was described by the late Mr. W. Thompson in part iii. vol. ii. of the 'Transactions of the Zoological Society.' This fish has anomalous characters, and Mr. Thompson had some difficulty in assigning it its proper position. The total length of the fish was 11 inches. As Dr. Drummond's specimen is the only one on record, nothing is known of the habits of the fish.

(Yarrell, *British Fishes*.)

ECHI'TES, a genus of twining Plants, inhabiting tropical countries, and belonging to the natural order *Apocynaceæ*. They have handsome yellow or white corollas, and are moreover remarkable for the singular fruit, which consists of two divaricating woody pod-like follicles containing a large number of silky seeds. There are above 60 species of this genus. They are dangerous lactescent plants, of no known use.

E'CHIUM (from ἔχις, a viper), a genus of Plants belonging to the natural order *Boraginaceæ*. It has a calyx with five deep segments; the corolla sub-bell-shaped, throat dilated, naked, limb irregular; the stamens exserted, filaments very long, unequal, style bifid; the nuts wrinkled, attached by a flat triangular base. The species are rough shrubby or herbaceous plants, with lanceolate or oblong-lanceolate leaves, and blue or white flowers.

E. vulgare, Viper's Bugloss, is covered with hispid tubercles, has an erect simple stem, the leaves lanceolate, 1-ribbed, the stem-leaves narrowed below, sessile, the flowers in short lateral spikes, the stamens longer than the corolla. It is a native of dry places in Great Britain and throughout Europe. It is a remarkably handsome plant. The flowers are at first reddish, and afterwards become blue.

E. violaceum is a pilose-hispid plant, with an erect branched diffuse stem, the lower branches prostrate, the radical leaves oblong-ovate, stalked, the stem-leaves oblong, narrowed from a cordate half-clasping base with lateral ribs, the spike panicled, elongate, simple, the stamens scarcely longer than the corolla. The root of this plant is red, and when kept in an herbarium stains the paper of a violet colour. It is a native of Jersey, also of the south of Germany, Spain, France, Italy, and the south of Taurida.

E. giganteum has a branched stem, hoary at the top, with petiolate-lanceolate leaves attenuated at the base; the panicles thyrsoid; the spikelets bifid. This plant is a shrub, with whitish-blue flowers, and attains a height of eight or ten feet, and is one of the largest species of the genus. It is a native of Teneriffe.

E. plantigineum, naturalised in Brazil, is used in that country as a pickle. The roots of *E. rubrum* yield a red dye, which is used in the arts.

Above 80 species of this genus have been described; they inhabit the temperate parts of all quarters of the globle, but are more especially European. A large number of the shrubby species are natives of the Canary Islands, and another entirely different group are inhabitants of the Cape of Good Hope. The great bulk of the European species are herbaceous, as well as those which inhabit South and North America. All the species are worthy of cultivation, and the European species are amongst the handsomest of the indigenous plants of Europe. The shrubby species are all greenhouse plants, and will grow in a mixture of sand, loam, and peat; and cuttings will strike under a hand-glass in this mixture. They may be also propagated by layering and by seed, which sometimes come to perfection in this country. The hardy species will grow very well in any common garden soil, and may be propagated by seeds sown in an open border, in the spring; their general treatment must be the same as other perennial, biennial, and annual plants. They are well adapted for flower-borders, and afford a pleasing variety by the different shades of blue which they exhibit.

(Don, *Dichlamydeous Plants*; Babington, *Manual*.)

ECHIURUS. [SIPUNCULIDÆ.]

ECPHYMO'TES (Fitzinger), a genus of Saurians belonging to the family of the *Iguanidæ*. It possesses the teeth and pores of the genus *Polychrus*, but with small scales on the body only. The tail, which is large, has great scales, which are rhombic and carinated. The head is 4-sided, and covered with small plates. The form is a little short and flattened, like that of some of the *Agamæ*, rather than like the slender shape of *Polychrus*. There are four species—*E. Fitzingerii* and *E. undulatus*, natives of Brazil; *E. obtusirostris*, native of Mexico; and *E. acutirostris*, a native of Brazil.

ECTOCARPACEÆ. [ALGÆ.]

ECTOPISTES. [COLUMBIDÆ.]

ECTOZOA (from ἐκτός, without, and ζωός, living), animals found living upon the external parts of other animals. This term is applied to distinguish the forms of animal life which are parasitic upon the surface of other animals from those which inhabit their interior. [ENTOZOA.] Whilst those which inhabit the interior of animals have so much resemblance to each other that naturalists place them together in an order which is called *Entozoa*, those which are found on the surface are very dissimilar, and belong to distant and dissimilar families. The term *Ectozoa* is therefore not one expressing any affinity between the animals included in it, but simply refers to their habitation.

The *Ectozoa* as well as *Entozoa* are found frequently associated with the diseased states of the animal bodies on which they are found, and much discussion has arisen as to whether they are the true causes of the diseases which they accompany. Thus much is certain, that whether they originate or not the diseased state of the body on which they are found, when allowed to increase they become themselves a source of diseased conditions, which disappear as soon as they are destroyed.

This is a general law equally applicable to parasitic plants as well as animals. So that it would appear that, although their first attacks may be invited by a diseased condition of the plant or animal on which they are found, they may be productive of destructive effects by an unnatural and unhealthy increase. Every species of plant and animal appears to be subject to the attacks of special forms of parasitic plants and animals; and with regard to the latter they may be either inside or outside, so that we have not only *Ectozoa* and *Entozoa*, but *Ectophyta* and *Entophyta*. [ENTOPHYTA.]

Under the term *Epizoa* a number of animals have been placed together whose claims to be regarded as a section of the great family *Crustacea* are now generally recognised. These are found more especially on the bodies of fish, infesting their skin, eyes, and gills. They are very numerous, and the larger number of them belong to the family *Lerneadæ*. [LERNEADÆ.] They must be regarded as the *Ectozoa* of aquatic animals. The bodies of the *Cetacea* are frequently the chosen residence of many species of *Cirripedia*. [CIRRIPEDIA.] These ecto-parasitic habits seem to be partaken of by some of the Vertebrate Animals, as we find the *Remora* [ECHENEIS] and other fish attaching themselves to the bodies of animals by an apparatus adapted for the purpose.

Land animals are subject to the attacks of various forms of *Ectozoa*, more especially those belonging to the Articulate tribes of animals. The following is a list of the creatures to which man is subject in various parts of the world:—

Phthirus inguinalis (Leach), the Crab-Louse; *Pediculus Capitis* (Nitzsch), Head-Louse; *Pediculus Vestimenti* (Nitzsch), Body-Louse; *Pediculus Tabescentium*, Burmeister [ANOPLURA]; *Sarcoptes Scabiei* (Latreille), Itch-Insect [ACARIDÆ]; *Dermanyssus Boryi* (Gervais); *Ixodes Americanus* (De Geer), Tick [IXODES]; *Argas Persicus* (Fischer); *Pulex penetrans* (Gmelin), Chigoe; *Pulex irritans* (Linn.), Common Flea [PULEX]; *Cimex lectularius* (Linn.), Bed-Bug [BUG]; *Œstrus Hominis* (Say), Gad-Fly [BOTS].

Other creatures are occasionally found taking possession of the surface of the human body. In diseased conditions the common fly has been known to deposit its ova in various parts of the body, and many of the insects which are parasitic upon the lower animals will take up their abode on the human body. This is the case with the various forms of the *Anoplura*, which are a peculiar species on almost every species of animal on which they are found, so also with the species of the genera *Pulex* and *Cimex*.

(Leidy, in *Flora and Fauna within Living Animals*.)

EDA'PHODON, a genus of Fossil Placoid Fishes, from the London Clay and Bagshot Sand. Three species. (Agassiz.)

EDDOES, the name by which the esculent *Caladium* is known by the blacks of the Gold Coast. [CALADIUM.]

EDELSFORSITE, a Mineral consisting of silicate of lime, &c. It occurs fibrous or feathery and massive. Its colour is white or grayish. Its hardness 6 (?). Its lustre shining. Transparent. The specific gravity 2·58. It is found at Aedelfors in Smaland, Cziklowa in the Banate, and in Norway. The following is its analysis:—Silica, 61·85; lime, 38·15, with small quantities of magnesia, alumina, and iron. Another compound under this name has also been called the Aedelfors Red Zoolite. It agrees in composition with *Stilbite*, except that it contains 2 per cent. less of water.

EDENTATA, a group of Mammiferous Animals brought together on account of their agreement in the comparatively unimportant character of the absence of incisive teeth in their jaws, and the length of their claws. Cuvier divided his *Edentata* into three tribes:—1. *Tardigrades*, including the Sloths. [BRADYPUS]. 2. The *Edentata* proper, including the Armadilloes (*Dasypus*) [ARMADILLO]; the Aard-Vark (*Orycteropus*) [ARD-VARK]; the Chlamyphore [CHLAMYPHORUS]; the Ant-Eaters (*Myrmecophaga*) [ANT-EATER]; and the Pangolins (*Manis*) [MANIS]. 3. The third tribe embraces the *Monotremes*, *Echidna*, and *Ornithorhynchus*. These last are mostly regarded as a group of at least equal value with the *Edentata*. [ECHIDNA; ORNITHORHYNCHUS.] The *Edentata* also include the gigantic toothless *Herbivora* of a former period in the world's history, and of which the *Megatherium* may be taken as a type. [MEGATHERIDÆ.]

In the list of the specimens of the *Mammalia* in the 'Collection of the British Museum,' the species of this group are distributed as follows:—

Order V. UNGULATA.

Family 4. DASYPIDÆ.

a. Manina.

Manis tetradactyla, the Phatagin.
M. multiscutata, Many-Shielded Phatagin.
M. pentadactyla, the Badgareit.
M. Javanica, the Tangiliu.

b. Dasypina.

Dasypus sexcinctus, the Armadillo.
Tatusia tricincta, the Apara.

T. septemcinctus, the Peba.
T. minuta, the Pichey.
Xenurus unicinctus, the Tatouay.
Priodonta gigas, the Tatou.

c. *Myrmecophagina.*

Orycteropus Capensis, the Aard-Vark.
Myrmecophaga jubata, the Tamanoir.
Tamandua tetradactyla, the Tamandua.
Cyclothurus didactylus, the Ant-Eater.

d. *Ornithorhynchina.*

Platypus anatinus, the Mullingong.
Echidna hystrix, the Echidna.
E. setosa, Brown Echidna.

Family BRADYPIDÆ.

Cholœpus didactylus, Unau.
Bradypus torquatus, the Gipakeiou.
B. gularis, the Yellow-Faced Sloth.
B. tridactylus, the Sloth or Ai.

EDINGTONITE, a Mineral, consisting of silicate of alumina, &c. It occurs in small right square prisms, with lateral cleavage. It is nearly colourless, and has a vitreous lustre. It has a hardness of 4 to 4·5, and a specific gravity from 2·7 to 2·75. It is found with Thomsonite, in Dumbartonshire.

EDRIOPHTHALMIA (Leach), a legion of Crustaceous Animals with sessile eyes, which are generally compound, but sometimes simple, situated on the sides of the head. Tho mandibles are often furnished with a palp, and the head is almost always distinct from the body.

Desmarest makes the *Edriophthalmia* comprehend the *Amphipoda* of Latreille, which, the former observes, Leach has not admitted, and which iucludes the two first sections of his legion of *Malacostraca Edriophthalmia*, and correspouds to the genus *Gammarus* of Fabricius.

The *Amphipoda* are characterised as having a head distinct from the trunk, aud formed of a single piece; mandibles provided with a palp; jaws to the number of three pairs, the external pair of which represent a lip with two palps or two small feet uuited uear its origin; a body laterally compressed, and divided into seven segmeuts; fourteen feet, of which the anterior are often terminated by a claw with a siuglo finger; vesiculous branchiæ situated at the internal base of the feet, with the exception of that of the anterior pair; tail composed of from six to seven articulations, and bearing underneath five pairs of false feet in form of filaments, with two very moveable branches. They are thus divided by Desmarest:—

The first section consists of those species whose antennæ are inserted one on each side of the front; whose tail is terminated by styliform filaments; and whose head is large and vertical. Example, *Phronima*, Latr., Leach, Lam., &c. &c.; *Cancer*, Herbst, Forsk.

The secoud (not admitted by Leach) comprises those with four antennæ; two flattened leaflets serving for fins, placed at the end of the tail, in place of the styles; and the head large and vertical. Example, *Hyperia*, Latr.

The third includes those which have four antennæ; the tail terminated by styliform filaments; the head moderately large and not vertical, aud contains six divisions, some of which are subdivided. *Talitrus*, Latr.; *Atylus*, Leach; *Dexamine*, Leach; *Melita*, Leach; *Gammarus*, Fabr.; *Podocerus*, Leach; *Corophium*, Latr.; *Cerapus*, Say, may be taken as examples of some of tho forms of these divisions and subdivisions.

The other orders arranged by Desmarest under the *Edriophthalmia* are the *Læmodipoda*, Latr., and the *Isopoda*, Latr.

M. Milne-Edwards makes the Edriophthalmians consist of the same orders, placing them as a legiou of the sub-class of Maxillated Crustaceans, next to tho legion of Podophthalmians. [CRUSTACEA.]

EDWARDSIA. [ACTINIADÆ.]

EDWARDSITE, a name for *Monazite*. [CERIUM.]

EEL. [MURÆNIDÆ.]

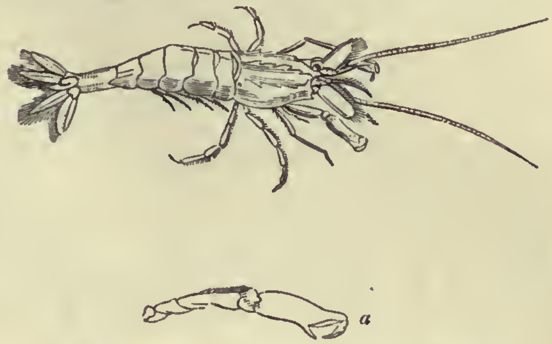
EEL, SAND. [AMMODYTES.]

EFT. The terms Eft and Newt are applied almost indiscriminately to all the species of Lizards which are found in the British Islands. The word lizard is evidently formed from *lacerta*, and is comparatively modern. Eft and Newt are the old Saxon words. Eft seems to be more usually applied to the land animals, one of the most common of which is the *Zootoca vivipara*, and another less common, the *Lacerta agilis*. Newt is more commonly applied to the animals which inhabit ponds, wet ditches, and other damp places, such as the *Triton cristatus* (the Great Water-Newt), *Lissotriton punctatus* (the Common Smooth Newt), and other species. [AMPHIBIA; SAURIA.]

EGEON, Risso's name for a genus of Macrourous Decapodous *Crustacea*, whose characters aro generally like those of the Shrimp [CRANGONIDÆ], but with the following differeuces. The fourth or last visible joint of the external jaw-feet is nearly twice as large as the preceding. The feet of the second pair are extremely short, slender, and didactylous; those of the third loug, very slender, and terminated by a single nail; those of tho fourth and fifth pairs larger, and ending by a compressed nail. The carapace elongated, cylindrical, spinous, and terminated anteriorly by a small rostrum.

The extreme brevity, observes Desmarest, of the second pair of feet, and the roughness of the carapace, are the most remarkable of theso differences; but they do not in his opinion present characters sufficient for the establishment of a genus.

E. loricatus, Risso; *Pontophilus spinosus*, Leach (see 'Trans. Soc. Linn.' t. xi., p. 346; and 'Malac. Brit.' tab. 37 A) has a carapace supporting three longitudinal dentelated carinæ above; rostrum very short; total length about an inch and a half. *Pontophilus spinosus* inhabits the coasts of England, those of Nice and the Adriatic Sea.



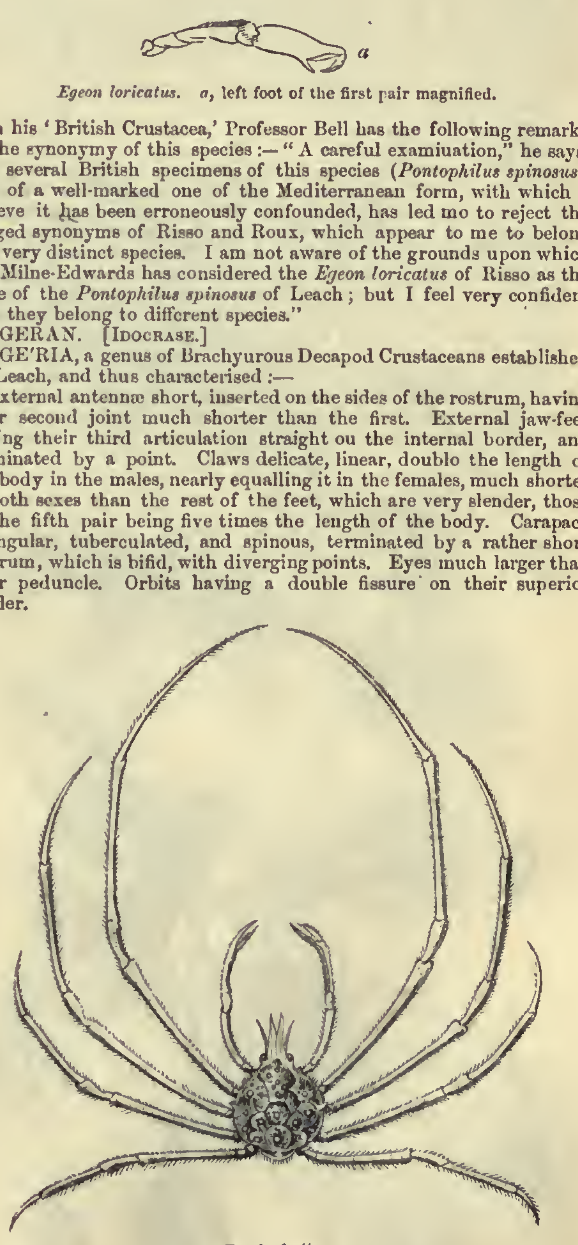
Egeon loricatus. *a*, left foot of the first pair magnified.

In his 'British Crustacea,' Professor Bell has the following remarks on the synonymy of this species:—"A careful examiuation," he says, "of several British specimens of this species (*Pontophilus spinosus*), and of a well-marked one of the Mediterranean form, with which I believe it has been erroneously confounded, has led mo to reject the alleged synonyms of Risso and Roux, which appear to me to belong to a very distinct species. I am not aware of the grounds upon which Dr. Milne-Edwards has considered the *Egeon loricatus* of Risso as the male of the *Pontophilus spinosus* of Leach; but I feel very confident that they belong to different species."

EGERAN. [IDOCRASE.]

EGE'RIA, a genus of Brachyurous Decapod Crustaceans established by Leach, and thus characterised:—

External antennæ short, inserted on the sides of the rostrum, having their second joint much shorter than the first. External jaw-feet having their third articulation straight ou the internal border, and terminated by a point. Claws delicate, linear, doublo the length of the body in the males, nearly equalling it in the females, much shorter in both sexes than the rest of the feet, which are very slender, those of the fifth pair being five times the length of the body. Carapace triangular, tuberculated, and spinous, terminated by a rather short rostrum, which is bifid, with diverging points. Eyes much larger than their peduncle. Orbits having a double fissure on their superior border.



Egeria Indica.

Desmarest observes that this genus, somewhat hastily established by Leach, if the uumber of articulations of the abdomen in the species which compose it were seven, would be nearly approximated to *Maia*, *Pisa*, *Mithrax*, and *Micippa*, in the form of the body; but the difference lies in the delicacy and disproportioned length of the feet. If the number of articulations composing it be six, as there is room for believing, although neither Latreille nor Leach say so positively, it would bear great relationship to the long-legged genera, *Macropodia*, *Leptopodia*, and *Doclea*, for example. But it has not the long, slender, divided rostrum, as well as the long claws larger than the feet, which characterise the first; nor does it present the very long, very slender, and entire rostrum, as well as the very elongated and linear claws, of the second; and finally, it has not the globular body and the very short and delicate claws of the last. It is removed from *Inachus* by the claws, which are proportionally shorter and less thick than those of the last-named crustaceans; by the other feet, which are relatively longer than theirs; by the antennæ, of which the first two joints of the base, and not the third, are longer than the others; and by the double fissure of the bottom of the orbits above.

E. Indica, in size, general form of the body, and length of the feet, bears a great resemblance to *Inachus Scorpio*; but besides the generic differences pointed out, it is still further removed from it in having a larger rostrum which is deeper incised in the middle, and in having the points with which the elevated and distinct regions of the carapace above are beset disposed in the following order: 3, 2, 1 and 1. A rather long sharp-post-ocular point is directed forwards. The arms are rather short and slender. It inhabits the Indian seas.

Egeria is also used by De Roissy for a genus of Conchifers, which M. Sander Rang considers identical with *Galathea*, Brug., and *Potamophilus*, Sow.

EGG. [REPRODUCTION IN ANIMALS.]

EGG-APPLES. [SOLANUM.]

EGG-PLANT. [SOLANUM.]

EGLANTINE. [ROSA.]

EGRET, the common name of several species of Heron. [ARDEA.]

EGYPTIAN BEAN, a name sometimes given to the bean-like fruits of *Nelumbium speciosum*, from the notion that they were the beans which the disciples of Pythagoras were forbidden to eat.

EHRETIA'CEÆ, *Ehretiads*, a small natural order of Exogenous Plants, consisting of shrubs or trees inhabiting the warmer countries of the world, and having rough leaves, monopetalous regular flowers, a definite number of stamens, a superior ovary, a 2-lobed style whose divisions are capitate, and a nucamentaceous undivided fruit. The flowers are more or less gyrate, and the order itself, which contains no species of economical value, is so near *Boraginaceæ* as to render it doubtful whether it ought to be separated. The common Heliotrope is the most generally known representative of *Ehretiaceæ*, forming however the type of a sectional division characterised by the fruit being dry, not succulent. There are 14 genera and 297 species of this order.

The root of *Ehretia buxifolia* is used in medicine in India. Some of the species of the genus *Ehretia* bear eatable drupes.

EIDER-DUCK. [DUCKS.]

EIRENE. [ACALEPHÆ.]

EKEBERGITE (*Sodaite*), a Mineral, consisting of a silicate of alumina, lime, and soda. It does not occur crystallised, but in compact or finely-fibrous masses, and occasionally in thin laminæ. Its colour is green, grayish, or brownish. The lustre is vitreous or resinous. It is transparent. The following is an analysis by Ekeberg:—

Silica	46
Alumina	28·75
Lime	13·50
Soda	5·25
Oxide of Iron	0·75
Water	2·25

ELÆAGNA'CEÆ, *Oleasters*, a small natural order of Apetalous Exogenous Plants, consisting of trees or shrubs whose leaves are either opposite or alternate, destitute of stipules, and always protected more or less by scurfy scales, which usually give the plants a leprous aspect. The genera of this order have a tubular 4-lobed calyx, the inside of which is lined with a fleshy disc, that sometimes almost closes up the tube; there are 3, 4, or 8 stamens, and a superior ovary containing a single erect ovule. The fruit is soft, succulent, and would be eatable if it were not for its dryness and insipidity. In a few cases, when it is more than usually juicy and acidulated, it is actually considered an excellent fruit. *Elæagnus hortensis* and *E. orientalis* bear a brown fruit about the size of an olive, which is brought to market in Persia under the name of Zinzeyd: in quality it is like a jujube. The red drupes of *E. conferta*, the large olive-shaped ones of *E. arborea*, and the pale orange-coloured ones of *E. triflora* are in like manner eaten in India; another occurs among the drawings of Chinese fruits. It is not a little curious, nearly as *Elæagnaceæ* are related to *Thymelæaceæ*, that they do not seem to participate in any degree in the acridity of that deleterious order. The only species found wild in Great Britain is the *Hippophaë rhamnoides*, a spiny shrub with diœcious flowers, small round orange-coloured acid berries, and narrow leaves like those of rosemary, found growing on cliffs near the sea; its fruit, when the acidity is sufficiently covered by sugar, becomes a rather pleasant preserve. *Elæagnus angustifolia*, called in the gardens the Olivier de Bohême, a native of the eastern parts of Europe, is one of the most fragrant of all plants. Its dull yellow flowers, hardly remarked among the leaves, fill the

Beurreria succulenta.

1, an ovary with the style and double stigma; 2, a ripe fruit with the calyx at the base; 3, a section of the same showing the seeds.

Elæagnus angustifolia.

1, a section of the tube of the calyx, showing the fleshy disc almost closing up the tube, the carpel, with its style and stigma, and the erect solitary ovule; 2, a ripe fruit; 3, the same cut away to show the single furrowed seed.

atmosphere with a delicious perfume, the source of which is not readily discovered by the passer-by. The genera comprising this order are *Elæagnus*, *Hippophaë*, *Conuleum*, and *Shepherdia*. They embrace about 30 species.

ELÆIS, a genus of Palms, so named from *Elaia*, the Olive-Tree, because an oil is yielded by the fruit of its principal if not only species. This is *Elæis Guineensis*, or Oil-Palm, Maba of the natives of the Congo. It is common all along the western coast of Africa. The tree is monœcious, as we are informed that both male and female spadices were obtained from a single plant cut down by Professor Smith. (Brown, in Tuckey's 'Congo.') The stem is tall, about ten inches in diameter, rough, and bristling with the persistent bases of the petioles, of which the margins, as in recent leaves, are fringed with spines. The leaves are pinnate, about 15 feet in length, with two rows of sword-shaped leaflets, each 18 inches long. The fruit is ovoid, about the size of a pigeon's egg, with its outer fleshy covering of a golden yellow colour; and like that of the section *Cocoinæ*, to which it belongs, and analogous to the cocoa-nut, has the foramina of its putamen at the apex, and not at the base, as represented by Gærtner and others.

Mr. Brown has observed it as remarkable that *Cocos Indica* and this palm, which is universally, and he believes justly, considered as having been imported into the West India colonies from the west coast of Africa, should be the only two species of an extensive and very natural section of palms that are not confined to America. The *Elæis occidentalis* of Swartz, the Thatch-Tree of Brown's 'Jamaica,' and the Avoira of Aublet, are probably all identical with the Maba, or Oil-Palm, of the African coast.

The oil is obtained by bruising the fleshy part of the fruit (and not the kernel as sometimes stated), and subjecting the bruised paste to boiling water in wooden mortars; an oil of an orange-yellow colour separates, which concretes when cool to the consistence of butter, and has when fresh the smell of violets or of the root of Florentine iris, with a very slightly sweetish taste. The oil is used by the Africans in cookery and for anointing the body. It forms a considerable article of commerce to Europe, where it is chiefly employed in perfumery and medicine. *Cocos butyracea* (which is referred by Kunth to the genus *Elæis*) is considered by the Edinburgh College to be the plant which yields palm-oil.

Mr. Brown (Tuckey's 'Congo,' Appendix, p. 456) states, "It is probable that *Alfonsia oleifera* of Humboldt, Bonpland, and Kunth belongs to *Elæis*, and possibly may not even differ from the African

Alfonsia oleifera.

species. To this the above authors in the 'Synopsis Plant. Æquinoct.' reply, that in *Elæis*, according to the description of Jacquin, both the floral envelopes are sexifid, while in *Alfonsia* they are trifid. If this moreover be the same as the corozo of Jacquin, another essential difference may be observed in the structure of the fruit of the two plants, the nut in *Elæis* being perforated at the apex, while the corozo has its nut perforated with three foramina at its base;" but this might have been inverted, as that of *Elæis* was by Gærtner. Humboldt and Bonpland moreover found *Alfonsia oleifera* always growing wild, while *Elæis Guineensis*, as they state, is never found except in a cultivated state out of Africa. The compressed nut of the *Alfonsia*, like that of the cocoa-nut, is described as yielding an oil, which is obtained by boiling in water the Manteca del Corozo; it is described as a liquid fat employed for ordinary lamps as well as those of churches.

ELÆOCARPA'CEÆ, *Eleocarps*, a natural order of chiefly Indian Trees, having a strong botanical resemblance to our European Lindens, but differing in having fringed petals, and anthers opening by two pores at the apex.

In the Indian genera, the nuts, cleared of the soft pulp or flesh that covers them, are curiously sculptured, and being bony and taking a fine polish they are frequently set in gold and strung into necklaces. The nuts of *Ganitrus sphæricus*, a middle-sized tree, common in various parts of India, as well as the Malay Archipelago, and those of *Menocera tuberculata*, from the forests of Travancore, are what are principally used for this purpose. The fruits of *Elæocarpus serratus*, which are very much like olives when ripe, are said by Roxburgh to be pickled or dried and used in their curries by the natives of India. *E. cyaneus* has pure white beautifully-fringed petals, and is one of the most ornamental plants of Australia. Lindley, in his 'Vegetable Kingdom,' places this order as a sub-order or division of *Tiliaceæ*.

A flowering shoot of *Elæocarpus cyaneus.*

1, a magnified flower; 2, a petal; 3, the stamens; 4, a ripe fruit; 5, the same cut away to show the wrinkled seed.

ELÆOCOCCA. [EUPHORBIACEÆ.]

ELÆODENDRON (from ἐλαία, an olive, and δένδρον, a tree), a genus of Plants belonging to the natural order *Celastraceæ*. It has a 5-parted calyx; 5 expanding linear-oblong petals; a 5-angled very thick fleshy disc; 5 anthers inserted into the margin of the disc; the filaments at length recurved; anthers with a thick connective, roundish, opening longitudinally; the ovary immersed in the disc, 2-celled; the ovules 2 in each cell; the style short, conical; the stigma simple, obtuse; the fruit drupaceous, dry, or pulpy; the nut 1-2-celled; the seeds usually solitary, with a membranaceous or spongy integument erect. The species are small trees with opposite entire glabrous leaves.

E. glaucum has elliptical serrated leaves, hardly three times longer than the petioles; the cymes loose, nearly the length of the leaves; the flowers pentandrous. It is a small tree, about 14 feet in height and is a native of Ceylon and Caromandel. The tree has been introduced into Great Britain from Ceylon under the name of Ceylon-Tea. It has leaves like those of the tea-plant, but it does not appear to be used as a substitute for that plant.

E. Roxburghii has oblong serrato-crenate, opposite and alternate, hard, smooth, shining leaves, about 4 inches long and 2 inches broad, with the petioles three-quarters of an inch long; the cymes globular, and three times the length of the petioles. It is a native of the mountainous parts of India. It possesses powerful astringent properties, but is not used as an internal medicine.

The fruit of all the species resembles that of the olive, and hence the generic name. *E. orientale* is a native of the Mauritius and Madagascar, where it is called by the French Bois d'Olive. *E. Argam* contains in its fruit a fixed oil like the common olive, which is used by the Moors for the same purpose as olive-oil is used in Europe.

The species of *Elæodendron* will grow freely in a mixture of loam and peat, and ripened cuttings will root in sand under a hand-glass.

(Lindley, *Flora Medica;* Loudon, *Encyclopædia of Plants;* Don, *Dichlamydeous Plants.*)

ELÆOLITE (*Fettstein*), a Mineral, consisting of a silicate of alumina, soda, iron, &c. It occurs in amorphous masses, with cleavages parallel to the lateral planes, and both diagonals of a rhombic prism. Its fracture is conchoidal. Colour dark green, bluish-gray, or grayish or brownish-red. The hardness is 5·5 to 6·0. The lustre resinous, frequently opalescent when cut. Translucent. The specific gravity is 2·54 to 2·62. It is found at Laurvig, Stavern, and Fredrickswärn in Norway. The following is an analysis by Vauquelin:—

Silica	44·00
Alumina	34.00
Soda	16·50
Peroxide of Iron	4·00
Lime	0·12

Gmelin found also 4·733 per cent. of potash, and only 0·651 per cent. of peroxide of iron.

ELAND. [ANTILOPEÆ.]

ELANET, a form of Hawk (*Falco melanopterus*, Daudin) inhabiting Africa, and also India and America. [FALCONIDÆ.]

ELAPHAS. [CERVIDÆ.]

ELAPHRIUM. [CALOPHYLLUM.]

ELAPS. [VIPERIDÆ.]

ELA'SMODUS, a genus of Fossil Placoid Fishes from the London Clay. (Egerton.)

ELA'SMOTHERIUM. [PACHYDERMATA.]

ELASTIC TISSUE. The elements of Elastic Tissue are cylindrical or band-like fibres with dark contours, very minute, and when present in large numbers they exhibit a yellowish colour. Hence it has been called Yellow Tissue. The fibres acquire sometimes little cavities in particular spots, which give these fibres a striated appearance, as seen in the giraffe. The elastic tissue is rarely found in large masses, but it is very frequently mixed with areolar tissue, either in single fibres or in networks of various kinds. [AREOLAR TISSUE.] The organs into which this tissue enters, and constitute their special feature, are:—

1. The elastic ligaments, in which the tissue with only a slight admixture of connective tissue and hardly any vessels and nerves exists, so to speak, in a pure form. Of these we have examples in the ligamentum subflava of the vertebræ, the ligamentum nuchæ, the ligament of the larynx, and stylo-hyoid ligament.

2. The elastic membranes which appear either in the form of fibrous networks or of fenestrated membranes, and are found in the walls of the vessels, especially in those of the arteries, in the trachea and bronchia, and in the fascia superficialis.

(Kölliker, *Manual of Histology*, translated by Busk and Huxley for the Sydenham Society.)

ELATE'RIDÆ, a family of Coleopterous Insects belonging to the section *Sternoxi* (Latreille), and, according to Linnæus, constituting the genus *Elater.*

The insects of this family are of a lengthened form; the head is, in nearly all cases, deeply inserted into the thorax; the thorax is usually of the same width as the elytra, or nearly so, longer than broad, and the posterior angles are acute, and most frequently produced into a pointed spine-like process: the elytra are long and narrow, cover the abdomen, and their external margins are often nearly parallel. The antennæ are of moderate length, either filiform, serrated, or pectinated, and when the insect is at rest they are deposited in two grooves on the under side of the thorax; at least such is the case in very many of the species. The legs are short and rather slender, and the femora and tibiæ are generally compressed.

These beetles are found upon flowers and upon the leaves of trees and plants; some species however are most frequently met with upon the ground.

When upon any elevated situation, if approached, they apply the legs and antennæ close to the body, and allow themselves to fall to the ground; if they fall upon their back they regain their natural position by a leap, which is always accompanied by a snapping noise similar to that which may be made by the finger-nails. When about to leap they bend the thorax backwards, so that the body is arched, or rather forms an angle, the insect then resting upon the apex of the abdomen and the fore part of the thorax. The leap appears to be effected by the sudden relaxation of the muscular effort which kept the thorax bent backwards, there being a peculiarity in its structure which causes it to spring forwards.

Even in a dried specimen, upon attempting to bend the thorax back, we found considerable resistance; but when allowed, it suddenly assumed its natural position, which is a slight inclination forwards.

There is a strong spine, it must be observed, on the under part of the thorax, at its base, which, when the thorax is in its usual position, is deposited in a groove; and it is said that the leap is performed principally by means of this spine, which is at the time forcibly pressed against the margin of the hollow, into which it sinks suddenly, as if by a spring. From this opinion we are inclined to differ; for upon removing the spine we found not the slightest alteration in that natural spring in the thorax which we before mentioned. Not however having at this moment the means of investigating the subject, it would be premature to venture any further remarks.

The larvæ of the *Elateridæ* feed most generally upon vegetable substances: rotten wood affords food to many; others live in the ground, and feed upon the roots of plants; one of them (the larva of *Elater striatus* of Fabricius) is said to attack the roots of the wheat and when in great numbers to do much injury.

These larvæ are long, rather slender, generally cylindrical, and covered with a tough skin: the head and terminal joint of the body are of a corneous texture; the latter is very variable in form, and is often depressed and produced into two bluntly-pointed processes: the former is furnished with the usual parts, such as jaws or mandibles, maxillæ, palpi, labrum, labium, and antennæ. The three segments which constitute the thorax are each furnished with a pair of short legs.

Of the insects included by Linnæus under the generic name of *Elater*, and others of similar general characters which have been discovered since that naturalist's time, there are upwards of five hundred species enumerated, and as these species (which are now regarded as constituting a family) are divided into about sixty genera, it will be impossible, consistent with the plan of this Cyclopædia, to enter into the detail of their characters. We will therefore confine ourselves to some of the more important,—in fact, to those which are given by Latreille in the 'Règne Animal:' these are as follows:—*Galba, Eucnemis, Adelocera, Lissomus, Chelonarium, Throscus, Cerophytum, Cryptostoma, Nematodes, Hemeripus, Stenicera, Elater* (proper), and *Camphylus.* These genera are divided by Latreille into two sections, in the first of which the antennæ are lodged (when the insect is at rest) within two grooves situated on the under side of the thorax.

This section includes the first six genera.

The genus *Galba* (Latreille) has the antennæ filiform, and received into two grooves situated directly under the lateral margin of the thorax; the joints of the tarsi are simple; the thorax is convex; the mandibles are terminated by a simple point; the maxillæ are furnished with a single small lobe; the terminal joint of the palpi is globular, and the body is nearly cylindrical. The species are all from Brazil.

The genus *Eucnemis* (Ahrens) differs from *Galba* chiefly in having the mandibles bifid at the apex, the maxillæ terminated by two lobes, the terminal joint of the palpi securiform, and the body nearly elliptical. Species of this genus are found in Europe and North America.

Adelocera (Latreille).—Here the antennæ are filiform; the joints of the tarsi are simple, and the anterior legs, when contracted, are received into lateral cavities in the under part of the thorax.

Lissomus (Dalman).—The species of this genus have little cushion-like lobes on the under side of each joint of the tarsi.

In the genus *Chelonarium* (Fabricius) the form approaches to an oval, the second and third joints of the antennæ are larger than the following, and of a flattened form, and these alone are received into the sternal grooves. The head is almost hidden by the thorax, which is semicircular, and the anterior legs are larger than the rest. All the species are from South America.

Throscus (Latreille).—This genus is readily distinguished by the antennæ being terminated by a three-jointed knob; the penultimate joint of each tarsus is bifid; the mandibles are simple.

The species of *Throscus* are very minute. *T. dermestoides*, an insect not uncommon in this country, is about one-eighth of an inch in length, of a brown colour, and obscurely covered with an ashy pubescence.

The second section of the *Elateridæ* comprises those species in which the antennæ are free, or not lodged within grooves on the under part of the thorax.

Cerophytum (Latreille).—The principal characters of this genus are:—Terminal joint of the palpi larger than the following, and almost securiform; tarsi with the four basal joints short and triangular, the penultimate joint bilobed; antennæ serrated in the female, and in the male branched internally.

The *C. Elateroides* (Latreille), an European species, affords an example of this genus.

Cryptostoma (Dejean).—Tarsi simple, small, and slender; anterior extremity of the præsternum projecting beneath the head; the apex of the third and seven following joints of the antennæ prolonged; mandibles unidentate; maxillæ with a single lobe; palpi very short.

C. denticornis (Latreille), the only species known, is from Cayenne.

Nematodes (Latreille).—Body nearly linear; antennæ with the basal joint elongated; each of the five following joints in the form of a reversed cone; the remaining joints almost perfoliate, with the exception of the last, which is oval.

Species of this genus have been found in Europe and North America.

Hemeripus (Latreille).—In this genus the parts of the mouth are exposed, that is, not, as in the last two genera, hidden by the projecting process of the præsternum; the antennæ are flabellate at the apex in the males.

All the species of this genus are extra-European.

In the genus *Ctenicera* (Latreille), the antennæ are pectinated in the males, and deeply serrated in the females.

The *C. pectinicornis*, an insect common in some parts of this country, affords an example of this genus. The species is rather more than half an inch in length, and of a brilliant metallic green or copper-like colour: the female is larger and broader than the male.

In the genus *Elater*, as now restricted, the antennæ are simply serrated.

The *E. æneus* of Linnæus will serve to illustrate this genus. This species, which is common in some parts of England, is generally found under stones on hills of but little elevation, and which are more or less covered with heath. It is about three-quarters of an inch in length, and most commonly of a brilliant green colour; some specimens however are blue, and others are of a brassy or bronze hue.

The *E. noctilucus*, according to Latreille, also belongs to this genus. This species is well known in South America, where it is called the Fire-Fly.* It is rather more than an inch in length, of a brown colour, and covered with an ashy down: on each side of the thorax there is a round glossy yellow spot. These spots emit by night a light so brilliant as to enable a person to read by it, and it is a common practice to place several of the insects together in a glass jar or bottle for this purpose. This insect (with upwards of twenty other species, all of which emit light by night) is now included in Illiger's genus *Pyrophorus*. The species of this genus are, some of them, from each of the following localities:—Brazil, Peru, Buenos Ayres, Chili, Cuba, St. Domingo, and Guyana.

In the genus *Campylus* (Fischer) the eyes are more prominent than in the other *Elateridæ*, and the head is protruded from the thorax; the antennæ are inserted beneath a frontal projection on each side, and the body is long and almost linear.

One species of this genus is found in England, the *C. dispar*, which is of a yellowish colour. In some specimens the head, legs, and antennæ are black, and sometimes the elytra are black with a broad pale margin.

ELATERIUM. [MOMORDICA.]

ELATINA'CEÆ, *Water-Peppers*, a natural order of Plants belonging to Lindley's Calycose group of Polypetalous Exogens. The sepals are 3-5, distinct, or slightly connate at the base; the petals hypogynous, alternate with the sepals; the stamens hypogynous, usually twice as numerous as the petals; the ovary with from 3 to 5 cells, an equal number of styles, and capitate stigmas; the fruit capsular, 3-5 celled, with the valves alternate with the septa, which usually adhere to a central axis; the seeds numerous, with a straight embryo, whose radicle is turned to the hilum, and little albumen. The species belonging to this order are annual plants with fistulous rooting stems, and opposite stipulate leaves, inhabitants of marshy places.

This order is nearly allied to *Caryophyllaceæ*, from which it has been separated by Cambessedes, on account of the different organisation of the seeds, capsules, and stigmas. It agrees with *Hypericaceæ* in many points, and especially in possessing receptacles for resinous secretions, but differs in having a persistent central axis in the fruit, definite stamens, and so forth. The species are found in marshy places and under water in all parts of the globe. Cambessedes arranged three genera in this order:—

1. *Merimæa* (named in honour of Prospero Merimes, an old botanist), with a 5-parted calyx; 5 petals; 10 stamens; 5 styles; a 5-valved, 5-celled, many-seeded capsule, the valve separating, and bent in at the margins so as to constitute dissepiments. This is a South American genus, of which but one species, *M. arenarioides*, a native of Brazil, has been described.

2. *Bergia* (after Peter Jonas Bergius, professor of natural history at Stockholm, and author of several works on botany), with a 5-parted calyx; 5 petals; 5 styles approximate; the capsule 5-valved, 5-celled from the edges of the cell being bent inwards. There are four species; one is a native of Egypt, one of Java, one of the East Indies, and one of the Cape of Good Hope.

3. *Elatine*, with a calyx 3-4-parted; 3-4 petals; 3-4 or 6-8 stamens; 3-4 styles; the capsules 3-4-celled, many-seeded, the seeds cylindrical, terete, straight or bent. There are five species of this genus.

* Other insects having the same power of emitting a light by night are undoubtedly confounded with the present species under the name of the Fire-Fly.

E. Hydropiper, Water-Pepper, has opposite leaves shorter then their petioles, the flowers stalked or nearly sessile, with 8 stamens and 4 ovate petals; the capsule roundish, depressed, 4-celled, the seeds bent almost double, pendulous, four in each cell. It has rose-coloured flowers. It grows under water, and is very common in ground subject to inundations throughout France. It is a very rare plant in Great Britain, and has been found only in Wales and Ireland. *E. hexandra* is a minute plant having 6 stamens. It forms small matted tufts under water, and is common in France, but rare in Great Britain. *E. tripetala* of Smith is identical with this species. *E. triandra* has been found in the neighbourhood of Ratisbon. *E. alsinastrum* is found near Paris.

In addition to the above genera, *Tetradiclis*, *Anatropa*, and *Tridia* are now enumerated. There are 6 genera and 22 species.

(Don, *Dichlamydeous Plants*; Babington, *Man. Brit. Bot.*)

ELATINE. [ELATINACEÆ.]

ELCAJA, an Arabian Plant, whose fruit is said to possess emetic properties. Botanists call it *Trichilia emetica*. Forskahl describes it as a large tree, with villous shoots, pinnated leaves, with entire oval-oblong pedicellate leaflets, clustered flowers with 5 greenish-yellow petals, 10 monadelphous stamens, and a downy capsular fruit about an inch long, with 3 valves, 3 angles, and 3 cells, having 2 plano-convex seeds in each cell. The tree is said to be called Roka, and to be common on the mountains of Yemen. The fruit is sold at Beit el fakih, for mixing with fragrant materials with which the Arab women wash their hair. The fruit called 'Djour elkai' is reputed an emetic. The ripe seeds mixed with Sesamum oil are formed into an ointment as a cure for the itch.

ELDER-TREE. [SAMBUCUS.]

ELECAMPANE. [INULA.]

ELECTRA. [CELLARIÆA.]

ELECTRIC-EEL. [ELECTRICITY OF ORGANIC BEINGS.]

ELECTRICITY OF ORGANIC BEINGS. Plants and animals under certain circumstances are known to exhibit electrical phenomena. These however are not so constant or frequent as is sometimes imagined. Considering the connection that is now known to exist between the great forces of nature, as Light, Heat, Chemical Action, and Electricity, it is perhaps matter of surprise that so few electrical phenomena are exhibited by organised bodies.

In Plants it appears that during growth electricity is developed. Pouillet filled several pots with earth, and placed in them different kinds of seeds, and then insulated them. During the process of germination no electric disturbance was discovered, but when the seeds began to sprout a gold-leaf electrometer had its leaves separated at least half an inch from each other. Pouillet concludes that the vegetation on the surface of the earth must produce a vast amount of electricity, and be an active cause of its phenomena in the atmosphere. Other observers have found that, by placing wires in the bark and pith of a growing tree, they have obtained decided indications of the presence of a galvanic current. These exhibitions of electric disturbance are undoubtedly dependent on the chemical changes going on in the plant, and this is one of the many instances in which we find one force in nature representing another. Under the influence of heat and light the chemical and attractive forces are brought into play, and the motile force of the growth of the plant as well as electrical phenomena are the result.

In the Animal Kingdom the same indications of the presence of electricity is afforded during the activity of the vital functions. Matteucci has observed a considerable deflection of the galvanometer when wires were connected with it passing from the liver and stomach of a rabbit. Other experimenters have obtained similar results. It has been supposed that these phenomena were due to the chemical changes going on in the body of the animal, but they cease on the death of the animal. Free electricity is excited by the movements of the human body. This is made evident by rubbing the feet on a woollen rug, when, on applying the hand to a gold-leaf electrometer, the presence of electric disturbance is indicated. Some persons are more liable to this development than others; and Dr. Carpenter says there are persons "who scarcely ever pull off articles of dress which have been worn next the skin without sparks and a crackling noise being produced, especially in dry weather."

Recent experiments of Matteucci and Du Bois-Raymond have shown not only that free electricity is developed in animal bodies, but that there is a true galvanic current both in the muscles and nerves. Galvani attributed the movements, first observed by his wife, induced in a frog's leg by plates of copper and zinc, to a purely animal action. Volta shewed that the movements observed by Galvani were dependent on the chemical action developed in the metals. Matteucci observed the peculiar sensibility of the nerves and muscles of the frog to galvanic action, and made use of the leg, prepared as a galvanometer, in many of his experiments. The mode of using it was simply to take the leg of a recently-killed frog with the crural nerve dissected out of the body, but remaining in connection with it. The leg was then inclosed in a glass tube covered with an insulating varnish, and the nerve allowed to hang freely at its open end. When two points of the nerve thus prepared are brought in contact with any two substances in a different electrical state, the muscles of the frog's leg are thrown into contraction. By this 'galvanscopic frog' Matteucci was able to detect currents of electricity in the muscles of animals, by cutting into them and placing one extremity of the nerve deep in the wound and the other at its lips. The experiments of Matteucci were followed up by Du Bois-Raymond, who has arrived at the following conclusions:—1. That galvanic currents may be observed in any limb of any animal whether cold or warm-blooded. These currents in some limbs are directed downwards, in others upwards. They are of different intensity in different limbs; but their intensity and direction are always the same in the same limb of different individuals of the same species. 2. The electro-motive action on which these currents depend does not arise from the contact of heterogeneous tissues, as Volta supposed; for the different tissues, the nerves, muscles, and tendons, in an electric point of view, are quite homogeneous. 3. These currents are produced by the muscles. If any undissected muscle of any animal be brought into the circuit longitudinally, it generally exhibits an electro-motive action, the direction of which depends on the position of the muscle. The current of the whole limb is nothing, but the resultant of the partial currents which are engendered by each muscle of the limb. It is therefore a 'muscular current.' 4. The law of the muscular current may be expressed as follows: "Any point of the natural or artificial longitudinal section of the muscle is positive in relation to any point of the natural or artificial transverse section." 5. By means of the above-mentioned law an explanation is afforded of the muscular current appearing in one instance an upward one, in another a downward one, which occurs according as the upper or the under of the two transverse sections is made to touch one of the ends of the galvanometer wire, whilst the other end is applied to the longitudinal section of the muscle. This is true even as regards shreds of muscle consisting of only a few primary fibres, and such as only admit of observation by the microscope. 6. The nerves are possessed of an electro-motive power which acts according to the same law as the muscles. Whilst still in organic connection with the muscles, and forming part of a circuit in which the muscles give rise to a current, the nerves simply play the part of an inactive conducting body, provided their own current be prevented from entering the circuit.

There are certain animals which possess the power of accumulating electric force within their bodies, and of discharging it at will in a violent form, and, with the exception of some insects and *Mollusca* which have been said (though this is doubtful) to communicate sensible shocks, these animals are all included in the class of Fishes. About seven species of this class, belonging to five genera, are known to possess electric properties, and it is curious that these genera belong to tribes very dissimilar from one another, and that, though each has a limited geographical range, one species or other is found in almost every part of the world. Thus, the three species of *Torpedo*, belonging to the Ray tribe, are found on most of the coasts of the Atlantic and Mediterranean, and sometimes so abundantly as to be a staple article of food. The *Gymnotus*, or Electric Eel, is confined to the rivers of South America. The *Silurus* (more correctly the *Malapterurus*), which approaches more nearly to the Salmon tribe, occurs in the Niger, the Senegal, and the Nile. The *Trichiurus*, or Indian Sword-Fish, is an inhabitant of the Indian Seas; and the *Tetraodon* (one of a genus allied to the *Diodon*, or Globe-Fish) has only been met with on the coral banks of Johanna, one of the Comoro Islands. These fishes have not all been examined with the same degree of attention, but it seems probable that the phenomena which they exhibit, and the structural peculiarities with which these are connected, are essentially the same throughout.

The peculiar characteristic of all is the power of giving, to any living body which touches them, a shock resembling in its effects that produced by the discharge of a Leyden jar. This is of very variable intensity in different species and individuals, and at different times. The *Gymnotus* will attack and paralyse horses, as well as kill small animals; and the discharges of large fish (which are 20 feet long) sometimes prove sufficient to deprive men of sense and motion. The effects of the contact of the *Torpedo* are less severe, and soon pass off; but the shock is attended with considerable pain when the fish is vigorous. The electrical organs appear to be charged and discharged to a certain extent at the will of the animals. Their power is generally exerted by the approach of some other animal, or by some external irritation; but it is not always possible to call it into action, even in vigorous individuals. It usually diminishes with the general feebleness of the system, though sometimes a dying fish exerts considerable power. All electrical fishes have their energy exhausted by a continued series of discharges; hence it is a common practice with convoys in South America to collect a number of wild horses and drive them into the rivers, in order to save themselves, when they pass, from being injured by the fish. If excessively exhausted, the animals may even die; but they usually recover their electrical energy after a few hours' rest.

The *Torpedo*, from its proximity to European shores, has been most frequently made the subject of observation and experiment; and the following are the most important results of the investigations which have been made upon it by various inquirers:—That the shock received by the organs of sensation in man is really the result of an electric discharge, has now been fully established. Although no one has ever seen a spark emitted from the body of one of the fish, it may be easily manifested by causing the *Torpedo* or *Gymnotus* to send its discharge through a slightly interrupted circuit. The galvanometer is influenced by the discharge of the *Torpedo*, and chemical decomposition may be effected by it, as well as magnetic properties communicated to needles. It seems essential to the proper reception of the shock, that two parts of the body should be touched at the same time, and that these two should be in different electrical states. The most energetic discharge is procured from the *Torpedo* by touching the back and belly simultaneously, the electricity of the dorsal surface being positive, and that of the ventral negative; and by this means the galvanometer may be strongly affected, every part of the back being positive with respect to every part of the opposite surface. When the two wires of the galvanometer are applied to the corresponding parts of the two sides of the same surface, no influence is manifested; but, if the two points do not correspond in situation, whether they be both on the back or both on the belly, the index of the galvanometer is made to deviate. The degree of proximity to the electric organ appears to be the source of the difference in the relative state of different parts of the body; those which are near to it being always positive in respect to those more distant. Dr. Davy found that, however much Torpedoes were irritated through a single point, no discharge took place; and he states that, when one surface only is touched and irritated, the fish themselves appear to make an effort to bring the border of the other surface, by muscular contraction, into contact with the offending body; and that this is even done by fœtal fish. If a fish be placed between two plates of metal, the edges of which are in contact, no shock is perceived by the hands placed upon them, since the metal is a better conductor than the human body; but if the plates be separated, and while still in contact with the opposite sides of the body, the hands be applied to them, the discharge is at once rendered perceptible, and it may be passed through a line formed by the moistened hands of two or more persons, the extremities being brought into relation with the opposite plates. The electrical phenomena of the *Gymnotus* are essentially the same with those of the *Torpedo*; but the opposite electrical states are found to exist, not between the dorsal and ventral surfaces, but between the head and tail; so that the shock is most powerful when the connection is formed between these two extreme points.

It has been ascertained by experiment, that the manifestation of this peculiar power depends upon the integrity of the connection between the nervous centres and certain organs peculiar to electrical fishes. In the *Torpedo* the electrical organs are of a flattened shape, and occupy the front and sides of the body, forming two large masses, which extend backwards and outwards from each side of the head. They are composed of two layers of membrane, between which is a whitish soft pulp, divided into columns by processes of the membrane sent off so as to form partitions like the cells of a honeycomb; the ends of these columns being directed towards the two surfaces of the body. The columns are again subdivided horizontally by more delicate partitions, which form each into a number of distinct cells; the partitions are extremely vascular, and are profusely supplied with nerves, the fibres of which seem to break up into minuter fibrillæ to form plexuses upon these membranes. The fluid contained in the electrical organs forms so large a portion of them, that the specific gravity of the mass is only 1·026, whilst that of the body in general is about 1·060; and from a chemical examination of its constituents, it seems to be little else than water, holding one-tenth part of albumen in solution, with a little chloride of sodium. The electrical organs of *Gymnotus* are essentially the same in structure, though differing in shape, in accordance with the conformation of the animal; they occupy one-third of its whole bulk, and run along nearly its entire length; there are however two distinct pairs, one much larger than the other. The prisms are here less numerous, but are much longer; for they run in the direction of the length of the body, a difference which is productive of a considerable modification of the character of the discharge. In the *Silurus* there is not any electrical organ so definite as those just described; but the thick layer of dense cellular tissue, which completely surrounds the body, appears to be subservient to this function; it is composed of tendinous fibres interwoven together, and of an albuminous substance contained in their interstices, so as to bear a close analogy with the cellular partitions in the special organs of the *Torpedo* and *Gymnotus*. The organs of the other known electrical fishes have not yet come under the notice of any anatomist.

In all these instances the electrical organs are supplied with nerves of very great size, larger than any others in the same animals, and larger than any nerve in other animals of like bulk. They all arise in the *Torpedo* from a ganglionic mass situated behind the cerebellum, and connected with the medulla oblongata, to which the name of 'electric lobe' has been given; the first two of them issue from the cranium in close proximity with the fifth pair, and have been regarded as belonging to it, although their real origin is different; whilst, from the distribution of the third electrical nerve to the stomach, after sending its principal portion to the electrical organ, it would seem analogous to the eighth pair or pneumogastric.

The electrical nerves in the *Gymnotus* are believed to arise from the spinal marrow alone; and those of the *Silurus* are partly intercostals and partly belong to the fifth pair. The integrity of the nerves is essential to the full action of the electrical organs. If all the trunks he cut on one side, the power of that organ will be destroyed, but that of the other may remain uninjured. If the nerves be partially destroyed on either or both sides, the power is retained by the portion of the organs still in connection with the centres. The same effects are produced by tying the nerves as by cutting them. Even slices of the organ entirely separated from the body, except by a nervous fibre, may exhibit electrical properties. Discharges may be excited by irritation of the brain when the nerves are entire, or of the part of the divided trunk distributed on the organ; but on destroying the electric lobe of the brain the electric power of the animal ceases entirely, although all the other ganglionic centres may be removed without impairing it. It is remarkable however that after the section of the electrical nerves Torpedoes appear more lively than before the operation, and actually live longer than others not so injured, which are excited to discharge frequently. Poisons which act violently on the nervous system have a striking effect upon the electrical manifestations of these fish; thus, two grains of muriate of morphia were found by Matteucci to produce death after about ten minutes, during which time the discharges were very numerous and powerful; and strychnia also excited powerful discharges at first, succeeded by weaker ones, the animals dying in violent convulsions. When the animals were under the influence of strychnia it was observed that the slightest irritation occasioned discharges; a blow given to the table on which the animal was placed being sufficient to produce this effect. If the spinal cord were divided however, no irritation of the parts situated below the section called forth a shock. It has also been ascertained by Mattencci that the electric power is suspended when the *Torpedo* is plunged into water at 32°, and is recovered again when it is immersed in water of a temperature from 58° to 68°; and that this alternation may be repeated several times upon the same fish. But if the temperature be raised to 86° the *Torpedo* soon ceases to live, and dies while giving a great number of violent discharges. (Carpenter.)

From these facts it is evident that the electric force is developed as the result of nervous agency. From this it has been sometimes hastily inferred that the electric and nervous forces are identical. This however is not more probable than that the contractile force of the muscles is identical with the nervous force. The best explanation of the phenomena appears to be the correlation of these forces. They are convertible forces, the one being capable of generating the other; the force generated being always the representative of the force generating it. The uses of these electric organs it is somewhat difficult to explain. The *Gymnotus* eats very few of the fishes which it kills by its shocks, and this is the case with the Torpedoes. Dr. John Davy conjectures that the electric discharges decompose the water, and supplying oxygen assist in respiration. Dr. Carpenter suggests that this peculiar action may assist the digestion of the fish, as animals killed by electricity are more digestible. The electrical condition of the animal itself he also thinks may conduce to the easy digestion of its food.

(Carpenter, *Principles of Physiology, General and Comparative;* Professor Matteucci, *Electro-Physiological Researches; Philosophical Transactions*, 1850; Matteucci, *Lectures upon the Physical Phenomena of Living Beings,* translated by Pereira; Du Bois-Raymond, *On Matteucci's Letter to Dr. Bence Jones*, editor of Dr. Du Bois-Raymond's *Researches in Animal Electricity;* H. Bènce Joues, *Abstract of Du Bois-Raymond's Researches in Animal Electricity.*)

ELENCHUS. [RHISSOPTERA.]

ELEO'CHARIS, a genus of Plants belonging to the natural order *Cyperaceæ* and the tribe *Scirpeæ.* It has fertile glumes, the lowermost layer with one or two of the lowest empty; 3-6 bristles. The nut compressed, crowned with the persistent dilated base of the style. There are 3 species of this genus, known by the name of Spike-Rushes, found in Great Britain.

E. palustris has a creeping root, and the stem clothed with membranous obtusely-truncate sheaths: it grows in marshy places, forming sometimes a large proportion of the peat found in bogs. *E. multicaulis* has slightly creeping roots, with the stem clothed with obliquely truncate rather acute sheaths. *E. acicularis* has a fibrous root, and numerous slender erect stems, and very small spikes. It is found in damp places upon heaths.

(Babington, *Manual of British Botany.*)

ELEOTRAGUS. [ANTILOPEÆ.]

ELEOTRIS, a genus of Acanthopterygious Fishes belonging to the family *Gobiodæ.* Like the Gobies the species have flexible spines in the first dorsal fin, and an appendage behind the vent, but they have the ventral fins separate and six gill-rays. The species are inhabitants of the fresh waters of warm countries, and conceal themselves in the mud.

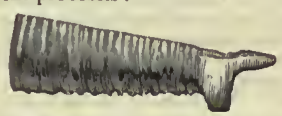
E. dormatrix, the Sleeper, is a large fish. It is found in the West Indian marshes. Other species have been found in Africa, India, and the Mediterranean.

ELEPHANT (in Latin *Elephas* and *Elephantus*, in Greek Ἐλέφας, in Spanish Elefante, in Italian Elefante, in French Elephant, in German Elephant, in Dutch Olyphant), the name of the well-known genus which forms the only living type of the family of true Proboscidians, or Pachydermatous Mammifers with a Proboscis and Tusks. It is the largest of existing terrestrial animals.

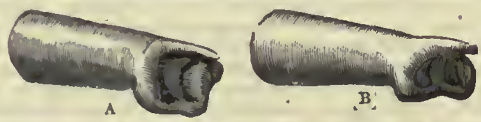
The Proboscis or Trunk, from which the name of the family is derived, demands some attention previous to our inquiry into the rest of the structure, habits, and history of the Elephants.

The great size of the alveoli necessary for the lodgment of the tusks renders, as Cuvier observes, the upper jaw so high and shortens the nasal bones to such a degree, that in the skeleton the nostrils are placed towards the upper part of the face; but in the living animal they are prolonged into a cylindrical trunk or proboscis composed of thousands* of small muscles variously interlaced, so as to bestow on it the most complicated powers of mobility in all the varieties of extension, contraction, and motion in every direction. It is of a tapering sub-conical form, and has internally two perforations. On the upper side of the extremity, immediately above the partition of the nostrils, is an elongated process, which may be considered as a finger; and on the under edge is a sort of tubercle, which acts as an opposeable point; in short, as a thumb. Endowed with exquisite sensibility, nearly 8 feet in length, and stout in proportion to the massive size of the whole animal, this organ, at the volition of the elephant, will uproot trees or gather grass—raise a piece of artillery or pick up a comfit—kill a man or brush off a fly. It conveys the food to the mouth, and pumps up the enormous draughts of water, which by its recurvature are turned into and driven down the capacious throat, or showered over the body. Its length supplies the place of a long neck, which would have been incompatible with the support of the large head and weighty tusks. A glance at the head of an elephant will show the thickness and strength of the trunk at its insertion; and the massy arched bones of the face and thick muscular neck are admirably adapted for supporting and working this powerful and wonderful instrument.

The following cuts will convey some idea of the form and action of the termination of the proboscis:—

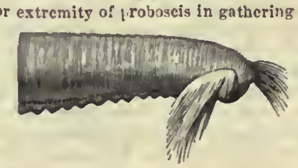


Anterior termination of Elephant's Trunk (profile).



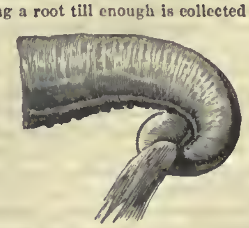
Anterior extremities of the trunks of male (A) and female elephants (B).

Action of anterior extremity of proboscis in gathering long herbage.



Mode of holding herbage when gathered.

Mode of holding a root till enough is collected for a mouthful.



Curled action, when a powerful grasp and much force is required.

* Cuvier gives the number of muscles having the power of distinct action as not far short of 40,000.

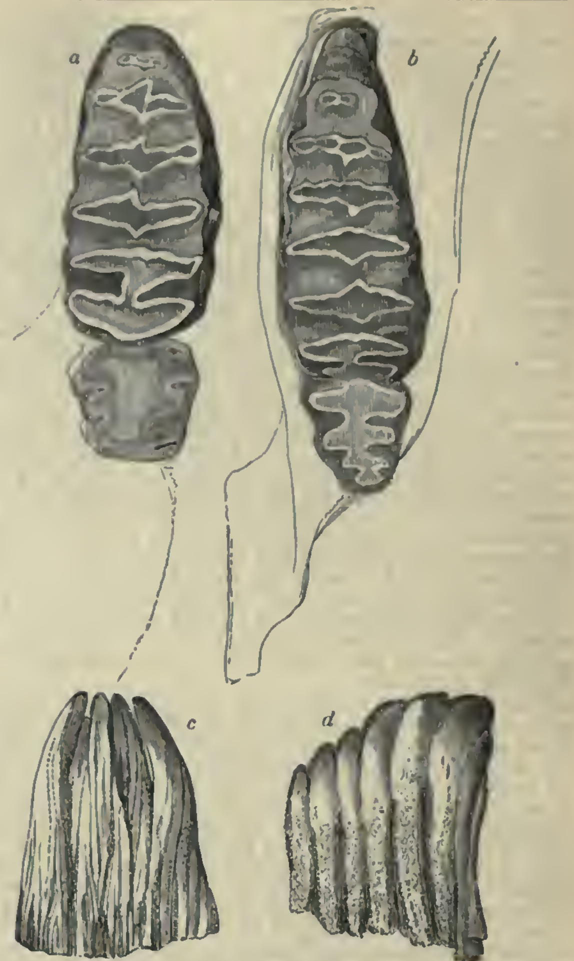
African Elephant: Incisors, $\frac{2}{0}$; Molars, $\frac{4}{4} = 10$.

Asiatic Elephant: Incisors, $\frac{2}{0}$; Molars, $\frac{2}{2} = 6$.

Dentition and Osseous Structure.—The succession of molar teeth in the elephants takes place in a direction from behind forwards; and the tooth last developed pushing against that which preceded it, and in time replacing it, gives as a result that there are never more than two molar teeth on each side of each jaw, and that sometimes there is only one. The last case happens immediately after the shedding of the anterior tooth, which has been pushed out by its successor, and which, in its turn, is to be replaced in like manner. This succession happens many times during the life of the animal, and Mr. Corse noticed it eight times in an Asiatic Elephant. Now, as these teeth show their anterior extremity first, long before the other extremity appears, and as they begin to be worn down anteriorly, it follows that the anterior tooth, when it is shed, is infinitely smaller in size than it once was, and that its form is entirely changed.

In the molar teeth of most graminivorous quadrupeds there is, besides the bony substance and enamel, a third component part, differing in appearance from both the others, but resembling the bone more than the enamel. Blake and others have distinguished this substance by the name of 'crusta petrosa;' Cuvier calls it 'cement.' The distinction of these three substances is perhaps better seen in the molar tooth of an elephant than in any other animal. If a longitudinal vertical section be made and the surface be polished, the crusta petrosa will be distinguished by a greater yellowness and opacity, as well as by a uniformity of appearance, there being no apparent laminæ nor fibres. "The grinding teeth of the elephant," writes Lawrence in his 'Additions' to Blumenbach, "contain the most complete intermixture of these three substances, and have a greater proportion of crusta petrosa than those of any other animal. The pulp forms a number of broad flat processes lying parallel to each other, and placed transversely between the inner and outer laminæ of the alveoli. The bone of the tooth is formed on these in separate shells, commencing at their loose extremities and extending towards the basis, where they are connected together. The capsule sends an equal number of membranous productions, which first cover the bony shells with enamel and then invest them with crusta petrosa, which latter substance unites and consolidates the different portions. The bony shells vary in number from 4 to 23, according to the size of the tooth and the age of the animal; they have been described under the name of denticuli, and have been represented as separate teeth in the first instance. It must however be remembered that they are formed on processes of one single pulp. When the crusta petrosa is completely deposited, the different denticuli are consolidated together. The bony shells are united at the base to the neighbouring ones; the investments of enamel are joined in like manner; and the intervals are filled with the third substance, which really deserves the name bestowed on it by Cuvier of 'cement.' The pulp is then elongated for the purpose of forming the roots or fangs of the tooth. From the peculiar mode of dentition of this animal, the front portion of the tooth has cut the gum and is employed in mastication before the back part is completely formed; even before some of the posterior denticuli have been consolidated. The back of the tooth does not appear in the mouth until the anterior part has been worn down even to the fang. A horizontal section of the elephant's tooth presents a series of narrow bands of bone of the tooth, surrounded by corresponding portions of enamel. Between these are portions of crusta petrosa; and the whole circumference of the section is composed of a thick layer of the same substance. A vertical section in the longitudinal direction exhibits the processes of bone upon the different denticuli, running up from the fangs; a vertical layer of enamel is placed before and another behind each of these. If the tooth is not yet worn by mastication, the two layers of enamel are continuous at the part where the bone terminates in a point; and the front layer of one denticulus is continuous with the back layer of the succeeding one, at the root of the tooth. Crusta petrosa intervenes between the ascending and descending portions of the enamel. As the surface of the tooth is worn down in mastication, the processes of enamel, resisting by their superior hardness, form prominent ridges on the grinding surface, which must adapt it excellently for bruising and comminuting any hard substance. The grinding bases, when worn sufficiently to expose the enamel, in the Asiatic species, represent flattened ovals placed across the tooth. In the African they form a series of lozenges, which touch each other in the middle of the tooth." In the Museum of the Royal College of Surgeons are a series of preparations (Nos. 350 to 354, both inclusive) illustrative of the structure and physiology of the molar teeth of elephants, preceded by an interesting extract from the Hunterian MS. Catalogue. No. 275 B is a portion of the cæmentum of an elephant's grinder, which has been steeped in an acid, dried, and preserved in oil of turpentine, for the purpose of showing the proportion of animal matter which it contains.

Nos. 262 to 264, both inclusive, show the interarticular ligamentous substance from the joint of the lower jaw of the elephant, and the adaptation of the structure for applying two convex surfaces to each other.



Teeth of African Elephant. From F. Cuvier.

a, Upper jaw; *b*, lower jaw; *c*, original state of the tooth when the laminæ which compose it are free; *d*, the laminæ as they are attached in parallels one to the other by the cortical substance in a subsequent state of dentition, but before the crown of the tooth has been worn by mastication, and when it only presents on its surface blunt tubercles.

Teeth of Asiatic Elephant. From F. Cuvier.
a, Upper molar tooth; *b*, lower molar tooth.

More than one molar tooth and part of another are never to be seen through the gum in the Elephaut. When the anterior tooth is gradually worn away by mastication, the absorption of its fangs and alveolus takes place, while the posterior tooth advances to occupy its position; then comes a third to take the place of the second tooth, which undergoes the same process, and so on, as we have stated, for at least eight times. Each succeeding tooth is larger than its predecessor. Thus, the first, or milk-grinder, which cuts the gum soon after birth, has but four transverse plates (denticuli); the second is composed of eight or nine, and appears completely when the animal is two years old; the third consists of twelve or thirteen, and comes at the age of six years; and in the fourth up to the eighth grinder both inclusive, the uumber of plates varies from fifteen to twenty-three. It would seem that every new tooth takes at least a year more for its formation than its predecessor. As the tooth advances gradually, a comparatively small portion only is through the gum at once. A molar tooth, composed of twelve or fourteen plates, shows only two or three of these through the gum, the others being imbedded in the jaw, and in fact the tooth is complete anteriorly, where it is required for mastication, while posteriorly it is very incomplete. As the laminæ advance, they are successively perfected. An elephant's molar tooth is therefore never to be seen in a perfect state; for if it is not worn at all anteriorly, the posterior part is not formed, and the fangs are wanting: nor is the structure of the back part of the tooth perfected until the anterior portion is gone.

Elephants have no canine teeth, but in the upper jaw there are two incisors, better known by the name of tusks. These enormous weapons are round, arched, and terminate in a point; and their capsule is always free, so that the tusk continues to grow as long as the animal lives. The structure of the ivory of which it is composed differs from other tusks; and a transverse section presents striæ forming the arc of a circle from the centre to the circumference, and, in crossing each other, curvilinear lozenges which occupy the whole surface. The tusk is hollow within for a great part of its length, and the cavity contains a vascular pulp, which supplies successive layers internally as the tusk is worn down externally. Blumenbach, iu his 'Comparative Anatomy,' observes, that not to mention other peculiarities of ivory, which have induced some modern naturalists to consider it as a species of horn, the difference between its structure and that of the bone of teeth is evinced iu the remarkable pathological phenomenon resulting from balls with which the animal has been shot when young being found, on sawing through the tooth, imbedded in its substance in a peculiar manner. Haller employed this fact, both to refute Duhamel's opinion of the formation of bones by the periosteum, like that of wood by the bark of a tree, as well as to prove the constant renovation of the hard parts of the animal machine. It is still more important in explanation of that 'nutritio ultra vasa,' which is particularly known through the Petersburgh prize dissertation. Blumenbach farther states that the fact above mentioned may be seen in Buffon (4to. ed., tom. xi. p. 161); in Galandat 'Over de Olyphants Tanden;' in the 'Verhandelingen der Genootsch, te Vlissingen,' tom. ix. p. 352; and in Bonn. 'Descr. Thesauri Hoviani,' p. 146. In all these cases, according to Blumenbach, the balls were of iron; and he adds that he possesses a similar specimen. In the cases we have seen, the balls were also of iron. "But," continues Blumenbach, "there is a still more curious example in my collection, of a leaden bullet contained in the tusk of an East Indian elephant, which must have been equal in size to a man's thigh, without having been flattened. It lies close to the cavity of the tooth; its entrance from without is closed, as it were, by means of a cicatrix; and the ball itself is surrounded apparently by a peculiar covering. The bony matter has been poured out on the side of the cavity iu a stalactitic form." Upou this Lawrence well remarks that the facts here recounted have been sometimes brought forward in order to prove the vascularity of the teeth; a doctrine which is refuted by every circumstance in the formation, structure, and diseases of these organs. When a bullet has entered the substance of the body, the surrounding lacerated and contused parts do not grow to the metal and become firmly attached to its surface, but they inflame and suppurate in order to get rid of the offending matter. "If the ivory be vascular," asks Mr. Lawrence, "why do not the same processes take place in it?" "We can explain very satisfactorily," writes Mr. Lawrence in continuation, "how a bullet may enter the tusk of an elephant, and become imbedded in the ivory without any opening for its admission being perceptible. These tusks are constantly growing during the animal's life by a deposition of successive laminæ within the cavity, while the outer surface and the point are gradually worn away; and the cavity is filled for this purpose with a vascular pulp, similar to that on which teeth are originally formed. If a ball penetrate the side of a tusk, cross its cavity, and lodge in the slightest way on the opposite side, it will become covered towards the cavity by the newly-deposited layers of ivory, while no opening will exist between it and the surface to account for its entrance. If it have only sufficient force to enter, it will probably sink by its own weight between the pulp and the tooth, until it rests at the bottom of the cavity. It there becomes surrounded by new layers of ivory; and as the tusk is gradually worn away and supplied by new depositions, it will soon be found in the centre of the solid part of the tooth. Lastly, a foreign body may enter the tusk from above, as the plate of bone which forms its socket is thin; if this descends to the lower part of the cavity, it may become imbedded by the subsequeut formations of ivory. This must have happened in a case where a spear-head was found in an elephaut's tooth. The long axis of the foreign body corresponded to that of the cavity. No opening for its admission could be discovered, and it is very clear that no human strength could drive such a body through the side of a tusk." ('Phil. Trans.,' 1801, part i.)

The great size to which these tusks grow may be judged of by examining the table published by Cuvier in his 'Ossemens Fossiles,' tom. i. p. 57. It is generally considered that the tusks of the African Elephaut are the largest; but with regard to the table, Cuvier observes that the African tusks could not be distinguished from those of the Indies, and that there is not the certainty that could be wished in the measures employed. According to Mr. Corse, the tusks of the Indian Elephant seldom exceed 72 lbs. in weight, aud do not weigh beyond 50 lbs. in the province of Tiperah, which produces thousands of elephants. There are however in London tusks which weigh 150 lbs., probably from Pegu; for it is from Pegu and Cochin-China that the largest Indian elephants and tusks are brought. The largest recorded in Cuvier's table was a tusk sold at Amsterdam, according to Klokner, which weighed 350 lbs.: this is stated on the authority of Camper; and one possessed by a merchant of Venice, which was 14 feet in length, and resting on the authority of Hartenfels, in his 'Elephantographia.' The largest in the Paris Museum is nearly 7 feet long, and about 5½ inches in diameter at the large eud. These tusks have different degrees of curvature.

Mr. Corse, speaking of the Asiatic Elephant, states that the first or milk tusks of an elephant never grow to any size, but are shed between the first and second year. These, as well as the first grinders, are named by the natives 'Dood-kau-Daunt,' which literally signifies milk-teeth. The tusks which are shed have a considerable part of the root or fang absorbed before this happens. The time at which the tusk cuts the gum seems to vary. Mr. Corse knew a young one which had his tusks when about five months old, while those of another did not cut the gum till he was seven months old. Those tusks which are deciduous, observes the same author, are perfect and without any hollow at the root, in a fœtus which is come to its full time, and at this period the socket of the permanent tusk begins to be formed on the inner side of the deciduous tusk: he gives the following examples of the progress of this part of the dentition:—A youug elephant shed one of his milk-tusks on the 6th of November, 1790, when near thirteen months old, and the other on the 27th of December, when about fourteen months old; they were merely two black-coloured stumps, when shed; but, two months afterwards, the permanent tusks cut the gum, and on the 19th of April, 1791, they were an inch long, but black and ragged at the ends. Wheu they became longer and projected beyond the lip, they soon were worn smooth by the motion and friction of the trunk. Another young elephant did not shed his milk-tusks till he was sixteen months old. The permanent tusks of the female are very small in comparison with those of the male, and do not take their rise so deep in the jaw; but they use them as weapons of offence in the same manner as the male, that is, by putting their head above another elephant, and then pressing their tusks down into the animal.

In the lower jaw there are neither incisors nor canines, and the molar teeth resemble those to which they are opposed.

Cuvier comes to the conclusion that the females of the African species have large tusks, and that the difference between the sexes in this respect is much less than in the Indian elephants; but Burchell attributes the want of success of the elephant-hunters whom he met with to their having only fallen in with females whose tusks were small.

Pursuing our inquiry into the general structure of the skeleton, we shall find a marked difference in the external appearance of the skulls of the African and Indian species.

Here we see that the almost pyramidical form of the skull in the Indian species is strongly contrasted with the more rounded form and contour of that of the African species. The front of the head is concave in the Indian species, while in the African it is rather convex; there are besides other differences.

Internally we find a beautiful provision for increasing the surface necessary for the attachment of muscles combined with strength and lightness.

The other parts of the skull most worthy of note are the nasal bones, of which the elephant possesses only a kind of imitation: the lachrymal bones are entirely wanting. The cervical vertebræ form a short and stiff series, allowing hardly more than a limited motion of the head from side to side, a more extended action being rendered unnecessary by the flexibility of the trunk, and a firm support for the head being the principal object to be attained. The spinous processes of the anterior dorsal vertebræ are exceedingly long for the attachment of the great suspensory ligament of tho neck (ligamentum nuchæ, or pax-wax). Blumenbach puts the number of ribs, and consequently of dorsal vertebræ, at 19 pairs, observing that this, at least, is the case in the skeleton of the Asiatic Elephant at Cassel. Blair, he remarks, found the same number in the individuals of which he has given an account; and a manuscript Italian description of the

Skull of African Elephant.

Skull of Indian Elephant.

Section of the Skull of Indian Elephant.

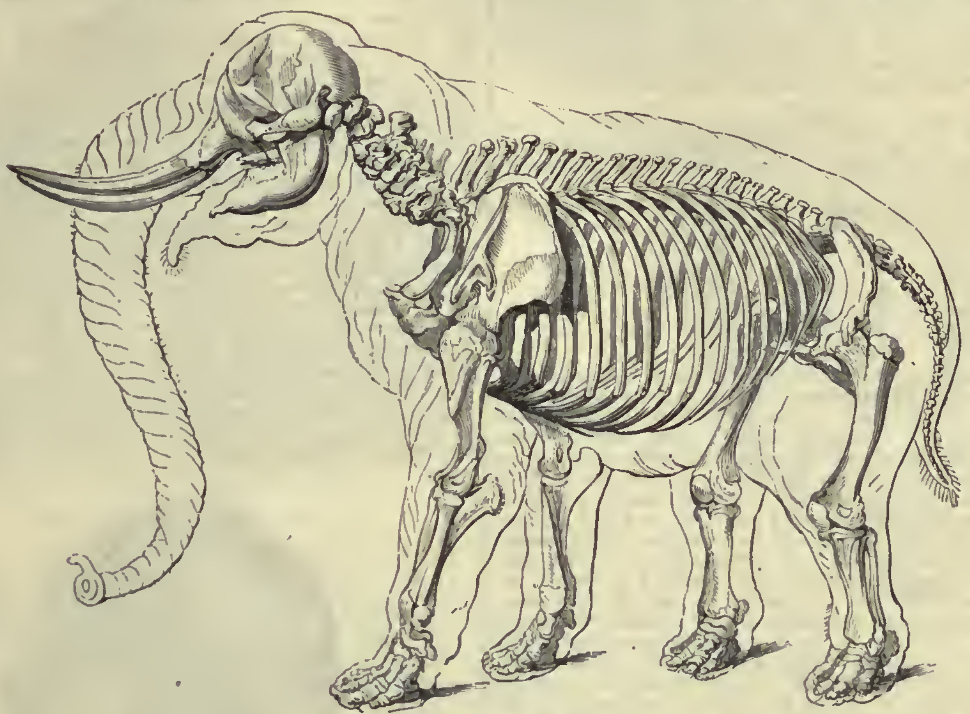
a, shows the opening of the nostrils; *b*, the cellular sinus which separates the external from the internal table of the skull; *c*, the cavity where the brain is lodged.

elephant which died at Florence in 1657 confirms this statement. Allen Moulins, on the contrary ('Anatomical Account of the Elephant burned in Dublin,' London, 1682, 4to.), and Daubenton, represent the number of pairs as 20. The elephant in the Museum of the Royal College of Surgeons (Chunce, formerly of Exeter Change) has 19 pairs of ribs; and that in the British Museum has the same number, 14 true and 5 false; but Dr. Gray informs us that in a second specimen of a young one, the bones of which have not been separated, there are 20 pairs, 15 true and 5 false. There are only three lumbar vertebræ. The margin of the scapula, which is turned towards the spine, and is shortest in most of the proper quadrupeds, is the longest in the Elephant, as it is in the *Cheiroptera*, most of the *Quadrumana*, and especially in man. There is no ligamentum teres, and consequently no impression on the head of the femur or thigh-bone.

Structure of Internal Soft Parts.—The following internal soft parts are more particularly worthy of remark in the Elephant:—Brain, &c., a portion of the dura mater from an Asiatic Elephant may be seen in the Museum of the Royal College of Surgeons, in London (Gallery, No. 1346), where the termination of the falx and the commencement of the tentorium, or process which separates the cerebrum from the cerebellum, are shown. The two fibrous layers of the dura mater are separated by a softer cellular substance, in which the vessels ramify; and it may be observed that the thickness of the dura mater is in proportion to the size of the skull, and of the entire animal, but not to the size of the brain, which does not much exceed that of the human brain, as will be seen in the preparation of the brain of a young Asiatic Elephant (No. 1331). For, though the absolute size of the organ exceeds that of man, the proportion which the cerebrum bears to the rest of the brain, and especially that part of the hemisphere which forms the roof and sides of the lateral ventricle, is much less. The hemispheres are broad and short, with a considerable development of the natiform protuberance. The convolutions are comparatively small and numerous. A lateral section has been removed from the left hemisphere, which shows that the anfractuosities are also deep, extending in some cases more than two-thirds of an inch into the substance of the brain. The hippocampus is comparatively smaller than in the ass, and the corpus striatum larger. The ventricle is seen to be continued into the olfactory bulb. The cerebellum is of considerable width, and its surface, as shown by the lateral section, is increased by numerous and complex anfractuosities. The tuber annulare corresponds in size to the development of the lateral lobes of the cerebellum. The corpora olivaria are remarkably prominent. The origins of all the cerebral nerves are shown, among which the olfactory nerves of the fifth pair, which supplies the proboscis, are remarkable for their prodigious size; whilst the optic nerves, and those which supply the muscles of the eye, are remarkable for their small size. The pia mater is left on with the vessels at the base of the brain. A bristle is placed in the infundibulum. ('Cat. Gallery,' vol. iii.). The brain in man is from $\frac{1}{22}$ to $\frac{1}{35}$ of the body, that of the elephant $\frac{1}{500}$. The stomach is simple, the intestines are very voluminous, and the cæcum enormous. In the sanguiferous system the heart is worthy of note, and a section of the right auricle and ventricle of that of an Asiatic Elephant may be seen in the museum last mentioned (Gallery, No. 924). In this animal, which, in some other respects, singularly resembles the *Rodentia*, three venæ cavæ terminate in the right auricle. Besides the Eustachian valve, which projects between the orifices of the inferior and left superior cavæ, there is also, as in the Porcupine, a rudiment of a superior valve, extending from the posterior side of the orifice of the right superior cava. The tricuspid valve, and its chordæ tendineæ and columnæ carneæ, are also well displayed. ('Cat. Gallery,' vol. ii.)

The period of gestation of the Elephant is twenty months and some days. The breasts of the female are placed under the chest, and the young one sucks, not with the trunk, but with the mouth. "The young of the elephant, at least all those I have seen," writes Mr. Corse, "begin to nibble and suck the breast soon after birth; pressing it with the trunk, which, by natural instinct, they know will make the milk flow more readily into the mouth while sucking. Elephants never lie down to give their young ones suck; and it often happens, when the dam is tall, that she is obliged for some time to bend her body towards her young to enable him to reach the nipple with his mouth; consequently, if ever the trunk was used to lay hold of the nipple, it would be at this period, when he is making laborious efforts to reach it with his mouth, but which he could always easily do with his trunk if it answered the purpose. In sucking, the young elephant always grasps the nipple (which projects horizontally from the breast) with the side of his mouth. I have very often observed this; and so sensible are the attendants of it, that with them it is a common practice to raise a small mound of earth, about 6 or 8 inches high, for the young one to stand on, and thus save the mother the trouble of bending her body every time she gives suck, which she cannot readily do when tied to her picket." The maternal affection does not seem to be very strong in the female elephant, at least in captivity; for the same author states that tame elephants are never suffered to remain loose, as instances occur of the mother leaving her young and escaping into the woods; and he says that if a wild elephant happens to be separated from her young, for only two days, though giving suck, she never afterwards recognises or acknowledges it. "This separation," adds Mr. Corse, "sometimes happens unavoidably, when they were enticed separately into the outlet of the Keddah. I have been much mortified at such unnatural conduct in the mother, particularly when it was evident the young elephant knew its dam, and by its plaintive cries and submissive approaches solicited her assistance."

and Merghee is termed Suukareah (from 'sunkarah,' a mixture), or Merghabauliah (for the most part Merghee); but a farther mixture or crossing of the breed renders it extremely difficult for the hunters to ascertain the variety. Besides the Koomareah, Merghee, and Sunkareah hreeds, several varieties are generally to be found in the same herd; but the uearer an elephaut approaches to the true



Skeleton of Elephant.

There are two living species of the genus *Elephas* :—

E. Indicus, the Asiatic Elephant. It differs from the African species, not only in its greater size and in the characters of the teeth and skull, but also in the comparative smalluess of the ears, the paler hrown colour of the skin, and in having four nails on the hind feet instead of three. The sagacity of this species is also supposed to be greater than that of the African Elephant. But though many wonderful stories are told, and some of them are as true as they are wonderful, of the grateful remembrance which it long retains of henefits conferred, or of the teuacity with which it "treasures up a wrong," and though the instances of its docility, hoth ancient and modern, are very extraordinary, we agree upon the whole with Barou Cuvier, who observes, that after having studied these animals a long time, he never found their intelligence snrpass that of a dog nor of many other carnivorous animals. It is imposing to see such a mountain of vitality obedient to the voice of its keeper, and performing feats at his dictation; and the massive gravity of its physiognomy assists the impression.

The following is Mr. Corse's description of a perfect Asiatic Elephant :—An elephant is said to he perfect when his ears are large and rounded, not ragged or indented at the margin; his eyes of a dark hazel-colour, free from specks; the roof of his mouth and his tongue without dark or black spots of any considerable size; his trunk large, and his tail long, with a tuft of hair reaching nearly to the ground. There must be five nails on each of his fore feet, and four on each of the hind ones, making eighteen in all; his head well set on, and carried rather high; the arch or curve of his back rising gradually from the shoulder to the middle, and thence descendiug to the insertion of the tail, and all his joints firm and strong.

The following are the castes (Zat) or varieties of the Asiatic Elephant noticed by Mr. Corse. Both males and females are divided into two castes hy the natives of Bengal, namely, the Koomareah (of a princely race) and the Merghee (hunting elephant, from 'mrigah,' a deer, or hunting, or from its slender make), and this without any regard to the appearance, shape, or size of the tusks in the male, as these serve merely to characterise some varieties in the species. The Koomareah is deep-bodied, strong, and compact, with a large trunk and short hut thick legs. The Merghee is generally taller but is not so compact nor so stroug: he travels faster, has a lighter body, and his trunk is both short and slender in proportion to his height. As a large trunk is considered a great beauty in an elephant, the Koomareah is preferred, hut not only for this, but for its superior strength, and greater capability of sustaining fatigue. The mixed hreed is held in greater or less estimation in proportion as it partakes of the qualities of the Koomareah or Merghee. A hreed from a pure Koomareah

Koomareah the more he is preferred, especially hy the natives, and the higher will be his price; though Europeans are not so particular, and will sometimes prefer a female Merghee for hunting and riding, when she has good paces, and is mild and tractable.

The variety of male termed Dauntelah (toothy, having large fine teeth,) produces the largest tusks aud the finest ivory: his head is strongly contrasted with that of the Mookuah (prohably from 'mookh,' the mouth or face), which can hardly be distinguished in this respect from a female elephant; and the tusks of some of the females are so small as not to appear beyond the lip, while in others they are almost as large as in the variety of male called Mooknah. The Dauntelah is generally more daring and less manageable than the Mooknah; and for this reason, until the temper and disposition are ascertained, the Europeans prefer the Mooknah; but the natives, who are fond of show, generally take their chance, and prefer the Dauntelah: and though there is a material difference in their appearance as well as in the value of their tusks, yet, if they are of the same caste, size, and disposition, and perfect, there is scarcely any difference in their price.

There are many varieties hetween the Mooknah and Dauntelah, and these are varied according to the variation of the form of the tusks, from the projecting horizontal but rather elevated curve of the Pullung-Daunt * of the true Dauntelah, to the nearly straight tusks of the Mooknah, which point directly downwards.

Thus the Goneish or Ganesa, which is a Dauntelah that has never had hut one tusk and this of the Pullung sort, and which is so called from Ganesa, the Hindoo god of wisdom, who is represented with a head like an elephant's with only one tooth, was sold in Mr. Corse's time to the Hindoo princes for a very high price, to be kept in state and worshipped as a divinity. Another variety of the Dauntelah has the large tusks pointing downwards and projecting only a little beyond the trunk: he is then said to have Soor or Choor-Daunt (Hog's teeth). A third is the Puttel-Dauntee, whose tusks are straight like those of the Mooknah, only much longer and thicker. The Ankoos-Daunteo is a fourth, and has one tusk growing uearly horizontal, like the Pulluug-Daunt, and the other like the Puttel-Daunt, and there are other less distinct varieties.

The term Goondah seems to he used to designate those wandering male elephauts which are much larger and stronger than the males generally taken with the herd, the Goondah departing from it or returning to it according to his desire. The Goondahs are supposed to be rarely taken with the herd: when they are so taken, their violence and ferocity reuder them most destructive. Mr.

* 'Pullung' signifies a bed or cot, and 'daunt' teeth; and, from the tusks projecting so regularly, and being a little curved and elevated at the extremities, the natives suppose a man might lie on them at his ease, as on a bed. (Corse.)

Corse relates an instance of the ungovernable passions and terrible havoc occasioned by the savage disposition of one, or at least a large male that was supposed to be one, when in the Keddah.* He was at length tied and led out, but his untameable spirit could not brook restraint, and after languishing about forty days he died.

Mr. Hodgson, in his paper 'On the Mammalia of Nepaul' ('Zool. Proc.,' 1834), suggests that there are two varieties, or perhaps rather species of the Indian Elephant, *Elephas Indicus*, namely, the Ceylonese, and that of the Saul Forest. The Ceylonese has a smaller and lighter head, which is carried more elevated; it has also higher fore quarters. The elephant of the Saul Forest has sometimes nails on its hinder feet.

The height to which the Asiatic Elephant will attain has been variously stated: but upon a strict examination of alleged great heights, the natural disposition among men to exaggerate has generally been detected.

A male elephant recorded by Mr. Corse was at its birth 35 inches high.

In one year he grew	11	inches,	and was	3	feet	10	inches high.
In the 2nd year	8	"	"	4	"	6	" "
In the 3rd year	6	"	"	5	"	0	" "
In the 4th year	5	"	"	5	"	5	" "
In the 5th year	5	"	"	5	"	10	" "
In the 6th year	3½	"	"	6	"	1½	" "
In the 7th year	2½	"	"	6	"	4	" "

A female elephant was 6 feet 9 inches high at the time she came into Mr. Corse's possession, and was supposed to be 14 years old according to the hunters; but, according to the belief of Mr. Corse, she was only 11 years of age. During the next 5 years, before she was covered, she grew only six inches, but, while pregnant, she grew 5 inches in 21 months, and in the following 17 months, though again pregnant, she grew only half an inch. Mr. Corse then lost sight of her. She was at this time about 19 years old, and had perhaps attained her full growth. Her young one was then not 20 months old, yet he was 4 feet 5½ inches high, having grown 18 inches since his birth. It thus appears that no certain standard of growth, for captive elephants at least, can be depended on: nor do there seem to be any satisfactory data for defining the age at which the animal ceases to grow. Mr. Corse conjectures that elephants attain their full growth between the ages of 18 and 24. With regard to the height, the East India Company's standard for serviceable elephants was, in Mr. Corse's time, 7 feet and upwards, measured at the shoulder in the same manner as horses are. At the middle of the back they are considerably higher; and the curve or arch, particularly in young elephants, makes a difference of several inches. The lessening of this curve is a sign of old age when not brought on by disease or violence. During the war with Tippoo Sultaun, of the 150 elephants under the management of Captain Sandys, not one was 10 feet high, and only a few males 9½ feet high. Mr. Corse was very particular in ascertaining the height of the elephants employed at Madras, and with the army under Marquis Cornwallis, where there were both Ceylon and Bengal elephants, and he was assured that those of Ceylon were neither higher nor superior, in any respect, to those of Bengal: nay, some officers asserted that they were considerably inferior in point of utility.

The only elephant ever heard of by Mr. Corse as exceeding 10 feet, on good authority, was a male belonging to Asaph Ul Dowlah, formerly vizier of Oude. The following were his dimensions:—

	Feet.	Inches.
From foot to foot over the shoulder	22	10½
From the top of the shoulder, perpendicular height	10	6
From the top of the head, when set up as he ought to march in state	12	2
From the front of the face to the insertion of the tail	15	11

And yet the Madras elephants have been said to be from 17 to 20 feet high. Now let us see how dimensions shrink before the severity of measurement. Mr. Corse heard from several gentlemen who had been at Dacca, that the Nabob there had an elephant about 14 feet high. Mr. Corse was desirous to measure him, especially as he had seen the elephant often at a former period, and then supposed him to be 12 feet high. He accordingly went to Dacca. At first he sent for the mahote, or driver, who without hesitation assured him that the elephant was from 10 to 12 cubits, that is, from 15 to 18 feet high; but added that he could not bring the elephant for Mr. Corse's examination without the Nabob's permission. Permission was asked and granted. Mr. Corse measured the elephant exactly, and was rather surprised to find that the animal did not exceed 10 feet in height.

The elephant is subject to albinism, and the white elephants so much esteemed by the Indian sovereigns are merely Albinos.

The Asiatic Elephant inhabits the greater part of the warm countries of Asia, and the large islands of the Indian Archipelago. Mr. Corse states that the elephants for the service of the East India Company are generally taken in the provinces of Chittagong and Tiperah; but from what he had heard, those to the southward of Chittagong, in the Birmah territories and kingdom of Pegu, are of a superior breed. In confirmation of this opinion, he observes that the elephants taken to the south of the Goomty River, which divides the province of Tiperah from east to west, were generally better than those taken to the north of that river; and though elephants were taken at Pilibet as far north as 29° N. lat. in the vizier of Oude's territories, yet the vizier, and also the officers of his court, gave those taken in Chittagong and Tiperah a decided preference, they being much larger and stronger than the Pilibet elephant. Till the year 1790 Tiperah was a part of the Chittagong province; and so sensible was the Bengal government of the superiority of the southern elephants for carrying burdens, enduring fatigue, and being less liable to casualties, that in the then late contracts * for supplying the army, the contractor was bound not to send any elephant to the military stations taken north of the Chittagong province. Hence Mr. Corse concludes the torrid zone to be the natural clime, and the most favourable for producing the largest, the best, and the hardiest elephant; and that when this animal migrates beyond the tropics the species degenerates. He speaks of elephants being taken on the coast of Malabar as far north as the territories of the Coorgah Raja; but adds that those were much inferior to the Ceylon elephant, and that from this circumstance the report of the superiority of the Ceylon elephant to all others probably originated. He remarks that most of the previous accounts respecting the Asiatic Elephant had been given by gentlemen who resided many years ago on the coast of Malabar or Coromandel, where, at that time, they had but few opportunities of seeing the Chittagong or the Pegu elephant.

* Keddah is the name of the inclosure into which the wild elephants are driven and then captured.

Mr. Hodgson, in the paper above noticed, states that *Elephas Indicus* and *Rhinoceros unicornis* are both abundant in the forests and hills of the lower region of Nepaul, whence, in the rainy season, they issue into the cultivated parts of the Tarâi to feed upon the rice crops.

Asiatic Elephant (*Elephas Indicus*).

In a state of nature the Asiatic Elephant lives in great herds, which are generally said to be under the conduct of the old males, or bulls, as they are sometimes termed. From time immemorial the species has been brought under the dominion of man,† and trained to swell the pomp of pageants, and add to the terrors of war, as well as to perform the more useful offices of a beast of burden and draught, and the more dreadful one of executing the sentence of death on criminals. It has been long made the companion of the sports of the Orientalist in the great hunting parties; and from the same early period has been made to minister to the wanton and cruel pleasures of Eastern princes, by being stimulated to combat not only with other elephants but with various wild animals. The reader will find in the second volume of the 'Menageries' in the 'Library of Entertaining Knowledge,' an abundant and amusing collection of anecdotes connected with this subject, as well as a complete History of the Elephant, both in the wild state and as the servant of man.

The tusks of both species still form, as they did from the earliest periods, a valuable article of commerce. The ivory which is now sought for useful purposes and ornaments of minor importance, was in great request with the ancient Greeks and Romans for various domestic uses, as well as for the chrys-elephantine statuary rendered so famous by Phidias. Of these rich statues the Minerva of the Parthenon, and especially the Olympian Jupiter, appear to have been the masterpieces.

E. Africanus, the African Elephant. This animal is less than the Asiatic. The head is rounded; the front convex instead of concave;

* Mr. Corse's paper was read before the Royal Society in 1799.

† The earliest extant account in any European language of the mode of capturing the Indian elephant is in Arrian, 'Indike,' chap. 13.

the ears are much larger than those of the Asiatic species; and the general number of nails on each hind foot is only 3 instead of 4.

It is found in Africa from Senegal to the Cape of Good Hope. Cuvier says that it is not known whether the species is found up the whole oriental side of Africa, or whether it is there replaced by the preceding species.

African Elephant (*Elephas Africanus*).

The flesh of this creature is relished by the inhabitants of many districts of Africa. Major Denham speaks of it as being esteemed by all, and even eaten in secret by the first people about the sheikh; and he says that, though it looked coarse, it was better flavoured than any beef he found in the country. The ancient Romans considered the trunk as the most delicious part; but Le Vaillant speaks of the foot as a dish for a king, and more recent travellers bestow on it equal praise. The disposition of this species is supposed to be more ferocious than that of the Asiatic Elephant, though its habits in a state of nature do not greatly differ. It is not now tamed; but there is good ground for believing that the Carthaginians availed themselves of the services of this species as the Indians did of those of the Asiatic Elephant. The elephants exhibited in the Roman arena by Cæsar and Pompey appear to have been African; and from them principally, if not entirely, the ivory for ornamental purposes and the statues before alluded to seems to have been taken. The tusks of this species are of great size.

The number of the tusks brought to England is very large. In Sheffield alone it is stated that upwards of 45,000 tusks are annually consumed. The workers in ivory in that town are above 500 in number, and the value of the tusks is about 30,000*l.* per annum.

Fossil Elephants.

The third and fourth divisions of the tertiary fresh-water deposits (Pliocene period of Lyell) abound in extinct species of recent genera, and among them the remains of Fossil Elephants are very numerous. The alluvium, the crag, the ossiferous caverns, the osseous breccias, and the subapennine formations afford the most numerous examples. Cuvier ('Règne Animal,' last edit.) observes that there are found under the earth, in almost all parts of both continents, the bones of a species of elephant approximating to the existing Asiatic species, but whose grinders have the ribands of enamel narrower and straighter, the alveoli of the tusks longer in proportion, and the lower jaw more obtuse. An individual, he adds, found in the ice on the coasts of Siberia, appeared to have been covered with hair of two sorts, so that it might have been possible for this species to have lived in cold climates. The species has, he concludes, long since disappeared from the face of the globe. This species he characterises ('Ossemens Fossiles') as having an elongated skull; a concave front; very long alveoli for the tusks; the lower jaw obtuse; the grinders larger, parallel, and marked with closer-set ribands of enamel; and he designates it as the Fossil Elephant (*Elephas primigenius* of Blumenbach; *Elephas Mammonteus* of Fischer; the Mammoth of the Russians).

Mammoths' or elephants' bones and tusks occur throughout Russia, and more particularly in Eastern Siberia and the arctic marshes, &c. The tusks are very numerous, and in so high a state of preservation that they form an article of commerce, and are employed in the same works as what may be termed the living ivory of Asia and Africa, though the fossil tusks fetch an inferior price. Siberian fossil ivory forms the principal material on which the Russian ivory-turner works. The tusks most abound in the Laichovian Isles and on the shores of the Frozen Sea; and the best are found in the countries near the arctic circle, and in the most eastern regions, where the soil in the very short summer is thawed only at the surface: in some years not at all. In 1799 a Tungusian, named Schumachoff, who generally went to hunt and fish at the peninsula of Tamut after the fishing season of the Lena was over, had constructed for his wife some cabins on the banks of the lake Oncoul, and had embarked to seek along the coasts for Mammoth horns (tusks). One day he saw among the blocks of ice a shapeless mass, but did not then discover what it was. In 1800 he perceived that this object was more disengaged from the ice, and that it had two projecting parts; and towards the end of the summer of 1801 the entire side of the animal and one of his tusks were quite free from ice. The summer of 1802 was cold, but in 1803 part of the ice between the earth and the Mammoth, for such was the object, having melted more rapidly than the rest, the plane of its support

Skull of Fossil Elephant (*Elephas Primigenius*).

became inclined, and the enormous mass fell by its own weight on a bank of sand. In March 1804 Schumachoff came to his Mammoth, and having cut off the tusks exchanged them with a merchant for goods of the value of 50 rubles. We shall now let Mr. Adams, from whose account these particulars are abridged, speak for himself:—

"Two years afterwards, or the seventh after the discovery of the Mammoth, I fortunately traversed these distant and desert regions, and I congratulate myself in being able to prove a fact which appears so improbable. I found the Mammoth still in the same place, but altogether mutilated. The prejudices being dissipated because the Tungusian chief had recovered his health,* there was no obstacle to prevent approach to the carcase of the Mammoth; the proprietor was content with his profit from the tusks, and the Jakutski of the neighbourhood had cut off the flesh, with which they fed their dogs during the scarcity. Wild beasts, such as white bears, wolves, wolverines, and foxes, also fed upon it, and the traces of their footsteps were seen around. The skeleton, almost entirely cleared of its flesh, remained whole, with the exception of one fore leg. The spine from the head to the os coccygis,† one scapula, the basin and the other three extremities, were still held together by the ligaments and by parts of the skin. The head was covered with a dry skin; one of the ears, well preserved, was furnished with a tuft of hairs. All these parts have necessarily been injured in transporting them a distance of 11,000 wersts (7330 miles); yet the eyes have been preserved, and the pupil of the eye can still be distinguished.‡ This Mammoth was a male, with a long mane on the neck, but without tail or proboscis." (The places of the insertion of the muscles of the proboscis are, it is asserted, visible on the skull, and it was probably devoured as well as the end of the tail.) "The skin, of which I possess three-fourths, is of a dark grey colour, covered with a reddish wool and black hairs. The dampness of the spot where the animal had lain so long had in some degree destroyed the hair. The entire carcase, of which I collected the bones on the spot, is 4 archines (9 feet 4 inches) high, and 7 archines (16 feet 4 inches) long from the point of the nose to the end of the tail, without including the tusks, which are a toise and a half (9 feet 6 inches, measuring along the curve; the distance from the base or root of the tusk to the point is 3 feet 7 inches) in length; the two together weighed 360 lbs. avoirdupois; the head alone with the tusks weighs $11\frac{1}{2}$ poods (414 lbs. avoirdupois). The principal object of my care was to separate the bones, to arrange them, and put them up safely, which was done with particular attention. I had the satisfaction to find the other scapula, which had remained not far off. I next detached the skin of the side on which the animal had lain, which was well preserved. This skin was of such extraordinary weight that ten persons found great difficulty in transporting it to the shore. After this I dug the ground in different places to ascertain whether any of its bones were buried, but principally to collect all the hairs

* He had fallen sick from alarm on first hearing of the discovery, as it was considered a bad omen.

† An error, as of 28 or 30 caudal vertebræ only 8 remained.

‡ This is doubtful; a dried substance is visible.

which the white bears had trod into the ground while devouring its flesh. Although this was difficult from the want of proper instruments, I succeeded in collecting more than a pood (36 pounds) of hair. In a few days the work was completed, and I found myself in possession of a treasure which amply recompensed me for the fatigues and dangers of the journey, and the considerable expenses of the enterprise. The place where I found the Mammoth is about 60 paces distant from the shore, and nearly 100 paces from the escarpment of the ice from which it had fallen. This escarpment occupies exactly the middle between the two points of the peninsula, and is 3 wersts long (2 miles); and in the place where the Mammoth was found this rock has a perpendicular elevation of 30 or 40 toises. Its substance is a clear pure ice; it inclines towards the sea; its top is covered with a layer of moss and friable earth half an archine (14 inches) in thickness. During the heat of the month of July a part of this crust is melted, but the rest remains frozen. Curiosity induced me to ascend two other hills at some distance from the sea; they were of the same substance, and less covered with moss. In various places were seen enormous pieces of wood of all the kinds produced in Siberia; and also Mammoths' horns (tusks) in great numbers appeared between the hollows of the rocks; they all were of astonishing freshness. How all these things could become collected there, is a question as curious as it is difficult to resolve. The inhabitants of the coast call this kind of wood Adamschina, and distinguish it from the floating pieces of wood which are brought down by the large rivers to the ocean, and collect in masses on the shores of the Frozen Sea. The latter are called Noachina. I have seen, when the ice melts, large lumps of earth detached from the hills mix with the water, and form thick muddy torrents which roll slowly towards the sea. This earth forms wedges which fill up the spaces between the blocks of ice. The escarpment of ice was 35 to 40 toises high; and, according to the report of the Tungusians, the animal was when they first saw it 7 toises below the surface of the ice, &c. On arriving with the Mammoth at Borchaya our first care was to separate the remaining flesh and ligaments from the bones, which were then packed up. When I arrived at Jakutsk I had the good fortune to repurchase the tusks, and thence expedited the whole to St. Petersburgh." The skeleton is now in the Museum of the Academy, and the skin still remains attached to the head and feet. A part of the skin and some of the hair of this animal were sent by Mr. Adams to Sir Joseph Banks, who presented them to the Museum of the Royal College of Surgeons. The hair is entirely separated from the skin excepting in one very small part, where it still remains attached. It consists of two sorts, common hair and bristles, and of each there are several varieties differing in length and thickness. That remaining fixed on the skin is of the colour of the camel, an inch and a half long, very thick set, and curled in locks. It is interspersed with a few bristles about three inches long, of a dark reddish colour. Among the separate parcels of hair are some rather redder than the short hair just mentioned, about four inches long; and some bristles nearly black, much thicker than horse-hair, and from twelve to eighteen inches long. The skin when first brought to the museum was offensive; it is now quite dry and hard, and where most compact is half an inch thick. Its colour is the dull black of the living elephants. ('On the Mammoth, or Fossil Elephant, found in the Ice at the Mouth of the River Lena in Siberia, with a Lithographic Plate of the Skeleton.' From the fifth volume of the 'Memoirs of the Imperial Academy of Sciences of St. Petersburg,' London, 1819, 4to.

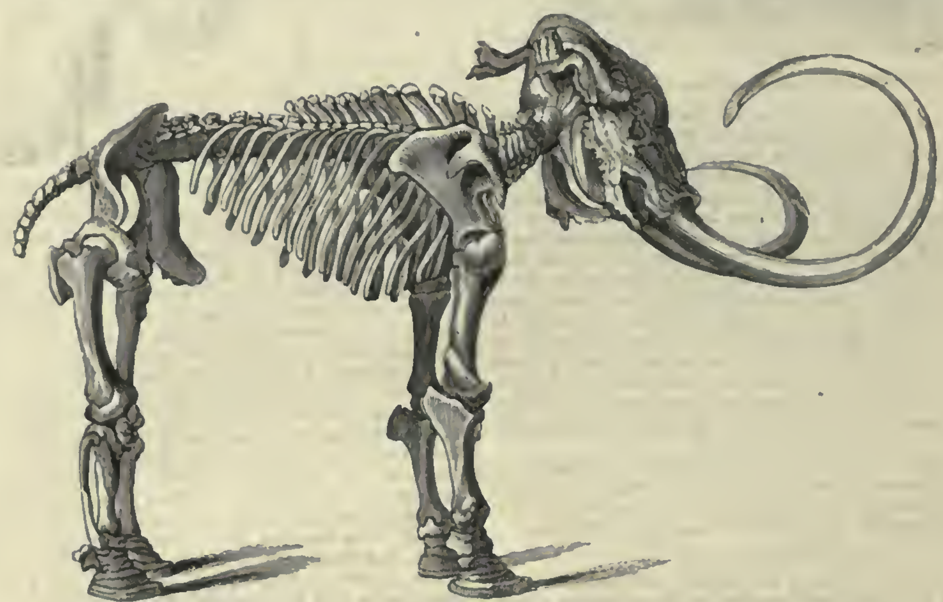
Remains of the *Elephas primigenius* have been found in great numbers in the British Islands. Mr. Woodward, in his 'Geology of Norfolk,' calculates that upwards of 2000 grinders of this animal have been dredged up by the fishermen off Happisburgh in the space of thirteen years. Along the coast of Suffolk the remains of the Mammoth are scarcely less numerous, especially in the pleistocene beds at Stutton. At the village of Walton, near Harwich, abundance of these remains have been found, mixed with the bones of the horse, the ox, and the deer. They have also occurred in many other parts of Essex. They are found at Herne Bay, in the valley of the Thames, at Sheppey, Lewisham, Woolwich, and the Isle of Dogs. They have been dug up in the streets of London, as in Gray's Inn Lane, and in Charles-street, St. James's Square. West of the metropolis they have been dug up at Kensington, Kew, Henley Bottom, Wallingford, and Dorchester. They occur on the south coast at Brighton, Hove, Worthing, Lyme Regis, and Charmouth. Districts in Worcestershire, Warwickshire, Staffordshire, Northamptonshire, Yorkshire, the celebrated cave at Kirkdale, have all yielded remains of this gigantic animal, frequently occurring with the remains of the hippopotamus and rhinoceros. Not only are these remains found on the dry land, but they have been dredged up repeatedly in the German Ocean and the British Channel.

"The remains of the Mammoth," says Professor Owen, "occur on the continent, as in England, in the superficial deposits of sand, gravel, and loam, which are strewed over all parts of Europe; and they are found in still greater abundance in the same formations of Asia, especially in the higher latitudes, where the soil which forms their matrix is perennially frozen.

"Remains of the Mammoth have been found in great abundance in the cliffs of frozen mud on the east side of Behring's Straits, in Eschscholtz's Bay, in Russian America, 66° N. lat.; and they have been traced, but in scantier quantities, as far south as the states of Ohio, Kentuckey, Missouri, and South Carolina.

"But no authentic relics of the *Elephas primigenius* have yet been discovered in tropical latitudes, or in any part of the southern hemisphere. It would thus appear that the primeval elephants formerly ranged over the whole northern hemisphere of the globe, from the 40th to the 60th, and possibly to near the 70th degree of latitude. Here, at least at the mouth of the river Lena, the carcass of a Mammoth has been found preserved entire, in the icy cliffs and frozen soil of that coast. To account for this extraordinary phenomenon geologists and naturalists, biassed more or less by the analogy of the existing elephants, which are restricted to climes where the trees flourish with perennial foliage, have had recourse to the hypothesis of a change of climate in the northern hemisphere either sudden and due to a great geological cataclysm, or gradual and brought about by progressive alternations of land and sea.

"I am far from believing that such changes in the external world were the cause of the ultimate extinction of the *Elephas primigenius;* but I am convinced that the peculiarities in its ascertained organisation are such as to render it quite possible for the animal to have existed as near the pole as is compatible with the growth of hardy trees or shrubs. The fact seems to have been generally overlooked that an animal organised to gain its subsistence from the branches or woody



Mammoth found in Siberia. Reduced from the lithographic plate mentioned at the end of the description.

fibre of trees is thereby rendered independent of the seasons which regulate the development of leaves and fruit; the forest-food of such a species becomes as perennial as the lichens that flourish beneath the winter snows of Lapland; and were such a quadruped to be clothed, like the Rein-Deer, with a natural garment capable of resisting the rigours of an arctic winter, its adaptation would be complete. Had our knowledge of the Mammoth indeed been restricted, as in the case of almost all other extinct animals, to its bones and teeth, it would have been deemed a hazardous speculation to have conceived, à priori, that the extinct ancient elephant, whose remains were so abundant in the frozen soil of Siberia, had been clad, like most existing quadrupeds adapted for such a climate, with a double garment of close fur and coarse hair; seeing that both the existing species of elephants are almost naked, or at best scantily provided when young with scattered coarse hairs of one kind only.

"The wonderful and unlooked-for discovery of an entire Mammoth, demonstrating the arctic character of its natural clothing, has however confirmed the deductions which might have been legitimately founded upon the localities of its most abundant remains, as well as upon the structure of its teeth, namely, that, like the Rein-Deer and Musk-Ox of the present day, it was capable of existing in high northern latitudes."

The kind of food partaken of by these creatures in their northern habitations did not probably differ much from that which they obtain at the present day in tropical climates. Their peculiar teeth enable them to derive a great proportion of their food from the woody fibre of tho branches of trees, and in this respect the structure of the teeth of the extinct species was analogous to that of the recent ones. Forests of hardy trees and shrubs still grow upon the frozeu soil of Siberia, and it is not unreasonable to suppose that at the time the Mammoth existed in the north of Europe it possessed an arboreal vegetation amply sufficient to supply the necessities of this animal, even in districts where the ground was covered during the greater period of the year with snow.

"We may therefore safely infer," says Professor Owen, "from physiological grounds, that the Mammoth would have found the requisite means of subsistence at the present day, and at all seasons, in the sixtieth parallel of latitude; and relying on the body of evidence adduced by Mr. Lyell, in proof of increased severity in the climate of the northern hemisphere, we may assume that the Mammoth habitually frequented still higher latitudes at the period of its actual existence. . . It has been suggested," observes the same philosophical writer, "that, as in our own times, the northern animals migrate, so tho Siberian Elephant and Rhinoceros may have wandered towards the north in summer.

"In making such excursions during the heat of that brief season the Mammoths would be arrested in their northern progress by a condition to which the Rein-Deer and Musk-Ox are not subject, namely, the limits of arboreal vegetation, which however, as represented by the dominating shrubs of polar lands, would allow them to reach the 70th degree of latitude. But with this limitation, if the physiological inferences regarding the food of the Mammoth from the structure of its teeth be adequately appreciated and connected with those which may be legitimately deduced from the ascertained nature of its integument, the necessity of recurring to the forces of mighty rivers, hurrying along a carcass through a devious course, extending through an entire degree of latitude, in order to account for its ultimate entombment in ice, whilst so little decomposed as to have retained the cuticle and hair, will disappear. And it can no longer be regarded as impossible for herds of Mammoths to have obtained subsistence in a country like the southern part of Siberia where trees abound, notwithstanding it is covered during a great part of the year with snow, seeing that the leafless trees during even a long and severe Siberian winter would not necessarily unfit their branches for yielding food to the well-clothed Mammoth. With regard to the extension of the geographical range of the *Elephas primigenius* into temperate latitudes, the distribution of its fossil remains teaches that it reached the 40th degree north of the equator.

"History in like manner records that the Rein-Deer had formerly a more extensive distribution in the temperate latitudes of Europe than it now enjoys. The hairy covering of the Mammoth concurs however with the localities of its most abundant remains, in showiug that, like the Rein-Deer, tho northern extreme of the temperate zone was its metropolis.

"Attempts have been made to account for the extinction of the race of northern elephants by alterations in the climate of their hemisphere, or by violent geological catastrophes, and the like extraneous physical causes. When we seek to apply the same hypotheses to explain tho apparently contemporaneous extinction of the gigantic leaf-eating *Megatheria* of South America, the geological phenomena of that continent appear to negative the occurreuce of such destructive changes. Our comparatively brief experience of tho progress and duration of species within the historical period is surely insufficient to justify, in every case of extinction, the verdict of violent death. With regard to many of the larger *Mammalia*, especially those which have passed away from the American and Australian continents, tho absence of sufficient signs of extrinsic extirpating change or convulsion, makes it almost as reasonable to speculate with Brocchi on the possibility that species, like individuals, may have had the cause of their death inherent in their original constitution, independently of changes in the external world, and that the term of their existence, or the period of exhaustion of the prolific force, may have been ordained from the commencement of each species."

Associated with the *Elephas primigenius* in the Tertiary Beds of England are the remains of another gigantic Proboscidean Animal belonging to the genus *Mastodon.* This genus possesses two enormous tusks projecting from the upper jaw, and was provided with a proboscis, as may be inferred from the length of the tusks, which would have prevented the mouth from reaching the ground. Like the Elephants they were destitute of canine teeth, and provided with a small number of large and complex molar teeth, successively developed from before backwards. The broad crowns of the molar teeth were also cleft by transverse fissures, but these clefts were fewer in number, of less depth, and greater width, than in the Elephants: the transverse ridges were more or less deeply bisected, and the divisions more or less produced in the form of udder-shaped cones, whence the name *Mastodon* (μαστός, and ὄδος), assigned by Cuvier to this genus of Proboscidean *Mammalia.* Two other dental characters pointed out by Professor Owen distinguish the genus *Mastodon* from the genus *Elephas.* The first is the presence of two tusks in the lower jaw of both sexes in the *Mastodon.* These are retained in the male but shed in the female. The second character is the displacement of the first and second molars in the vertical directiou by a tooth of simpler form than the second.

One species of *Mastodon* has been found in England, the *M. angustidens* of Owen, the Mastodon à Dents Etroites of Cuvier. Remains of it occur in the formation called by Sir Charles Lyell the Fluvio-marine Crag. It belongs to the Older Pliocene division of the Tertiary System.

A species of *Mastodon* larger than the *M. angustidens* of Europe has been found fossil in many parts of the United States. This is the *M. giganteus.* A specimen of the auimal nearly perfect was obtained in the state of Missouri in 1840. It was exhibited at the Egyptian Hall, Piccadilly, London, in 1842 and 1843, under the name of the 'Missouri Leviathan.' It was strangely distorted; but having been purchased by the Trustees of the British Museum it has been made to assume its correct proportions, and is now one of the chief objects of attraction in that national collection. The following are the proportions of this gigantic skeleton:—Extreme length, 20 feet 2 inches; height, 9 feet 6¾ inches: cranium, length, 3½ feet; vertical dimensions, 4 feet; width, 2 feet 11 inches; width of pelvis, 5 feet 8 inches: tusks, extreme length, 7 feet 2 inches; projection of the same, 5 feet 2 inches; circumference at the base, 27 inches. It was found near the banks of the river La Pomme de Terre, a tributary of the Osage River, in Burton county, Missouri. The bones were imbedded in a brown sandy deposit full of vegetable matter, with recognisable remains of the cypress, tropical cane, swamp-moss, stems of the palmetto, &c., and this was covered by beds of blue-clay and gravel to a thickness of about fifteen feet. Mr. Koch, the discoverer, states that an Indian flint arrow-head was found beneath the leg-bones of this skeleton, and four similar weapons wero imbedded in the same stratum. This indicates that the formation was more recent than that in which the remains of the British *Mastodon* had been found. Other remains of this *Mastodon* have been found in America, especially in the Big Bone Lick, in Kentucky, where it is said the remains of not less than 100 mastodons, 20 mammoths, with bones of the megalonyx, stag, horse, and bison, havo been discovered.

Amongst the remarkable remains brought from the Sewalik Hills, in Hindustan, by Captain Cautley and Dr. Falconor are the remains of several species of the genus *Elephas* and other proboscidean animals. Dr. Falconer, speaking of the group of animals thus revealed by his researches, says:—

"This fossil Fauna is composed of representative types of *Mammalia* of all geological ages, from the oldest of the tertiary periods down to the most modern; and of all the geographical divisions of the old continent, grouped together into one comprehensive assemblage. Among the forms contaiued in it there are—of tho *Pachydermata* several species of *Mastodon*, Elephant, Hippopotamus, Rhinoceros, *Anoplotherium*, and three species of *Equus*; of the *Ruminantia* the colossal genus *Sivatherium*, which is peculiar to India, with species of *Camelus*, *Bos*, *Cervus*, and *Antilope*; of the *Carnivora*, species of most of the great types, together with several undescribed genera; of the *Rodentia* and *Quadrumana* several species; of the *Reptilia*, a gigautic tortoise (*Colossochelys*), with species of *Emys* and *Trionyx*, and several forms of Gavials aud Crocodiles. To these may be added the remains of Struthious and other birds, and Fishes, *Crustacea*, and *Mollusca*."

The genus *Elephas* in this collection which has beon deposited in the British Museum includes six species.

E. planifrons, distiuguished by the flatness of the forehead and the intermediate character of its molar teeth.

E. Namadicus, with a great development of the cranium, aud teeth closely allied to those of the Indian species.

E. Hysudricus, with a turban-like vortex of the skull and teeth, whose structure approaches that of the African Elephant.

E. Ganesa is the most remarkable of the Sewalik species. A skull exists with remains of the other species in the British Museum. The total length of the cranium and tusks is 14 feet; length of the skull 4 feet 2 inches; width 29 inches; width of the muzzle 2 feet; length of the tusks 10 feet; circumference of the tusk at the base 26 inches.

The other two species are named *E. insignis* and *E. bombifrons*.

The species of *Mastodon*, in the collection from the Sewalik Hills, are *M. Perimensis*, *M. Siralensis*, and *M. latidens*.

Professor Owen states that a species of *Mastodon*, nearly allied to *M. angustidens*, has left its remains in the ossiferous caves and post-tertiary or newer tertiary deposits of Australia. From the conformity of the molar teeth Cuvier regarded a *Mastodon* whose remains have been discovered in Peru as identical in species with the *M. angustidens* of Europe. Professor Owen regards the *M. longirostris* of Kaup, found in Germany, and the *M. Arvernensis* of Croizet and Jobert, dug up in Auvergne, as identical with his *M. angustidens*.

In the collection of the British Museum, in addition to the species which we have mentioned above, will be found remains of *Elephas priscus* and *E. meridionalis*, found in Europe. There is also the remains of a species of *Mastodon*, *M. Andium*, from Buenos Ayres.

(Owen, *British Fossil Mammals and Birds*; Falconer and Cautley, *Fauna Antiqua Siralensis*; Mantell, *Petrefactions and their Teachings*.)

ELEPHANT'S FOOT. [TESTUDINARIA.]

ELEPHA'NTOPUS (from ἐλέφας, an elephant, and πούς, a foot, on account of the shape of its radical leaves), a genus of Plants belonging to the natural order *Compositæ*, the sub-order *Corymbiferæ*, the tribe *Vernoniaceæ*, the sub-tribe *Vernonieæ*, and the division *Elephantopeæ*. It has heads containing 3-4-5 florets, equal flowered, closely collected into a cluster, surrounded by leaves; the involucre compressed in two rows, the leaflets dry, oblong, alternately flat and folded, the inner usually 3-nerved; the receptacle naked; the corolla palmate, with a 5-cleft limb, which has acuminate segments and one recess deeper than the others; the filaments smooth, the branches of the style half subulate; the achenium rather compressed, many ribbed, oblong, hairy; the pappus in one row consisting of several straight paleæ, dilated at the base, but otherwise very narrow, acuminate, equal, and serrated.

E. scaber has a hairy dichotomous stem, the radical leaves scabrous, cuneate, and very much narrowed at the base, those of the stem lanceolate. This plant is common in almost all parts of India, in dry elevated positions. It has a stem a foot high, with the heads of pale-red flowers on long stalks. The roots are fibrous. Both the roots and the leaves are reputed to have active medical properties. The natives on the Malabar coast use a decoction of them in cases of dysuria. There are other species natives of South America and the West Indies.

(Lindley, *Flora Medica*; Loudon, *Encyclopædia of Plants*.)

ELETTA'RIA, a genus of Plants belonging to the natural order *Zingiberaceæ*. The characters of this genus are the same as *Amomum*, but the tube of the corolla is filiform and the anther naked. [AMOMUM.]

E. Cardamomum, True Cardamom, is a native of the mountainous districts of the coast of Malabar, especially above Calicut, in the Wynaad district, between 11° and 12° N. lat., where the best are produced. It is therefore well placed; for Cardamoms formed a portion of the early commerce, which subsisted between this part of India and Arabia, whence they must have been made known to the Greeks, as they are described by Dioscorides, and mentioned as early as the time of Hippocrates.

The Cardamom plant delights in moist and shady places on the declivities of the hills. It is cultivated from partings of the root in the district of Soonda Balaghaut, but the fruit is very inferior; the best grows in a wild state, at least where no other measures are adopted than clearing away the weeds from under the largest trees, which are felled close to the roots. The earth being loosened by the force of the fallen tree, young Cardamom plants shoot forth in a month's time, and are sheltered by the shade of the branches. The tree-like herbaceous plants attain a height of from 9 to 12 feet. The root is as tortuous and tuberous as that of the ginger, and the leaves, with long sheathing foot-stalks, are from one to two feet in length, placed in two rows, and lanceolate in shape, like those of the Indian Shot (*Canna Indica*) common in English gardens. The scapes, or flower- and fruit-bearing stalks, make their appearance in February of the fourth year, from the base of the stems, are three to four in number, and from one to two feet long, lax, and resting on the ground. The fruit is ripe in November, and requires nothing but drying in the sun to be fit for commerce. The seeds are gratefully aromatic and pungent with a flavour of camphor, and are regarded as a necessary article of diet by the inhabitants of Asia. They are used in medicine, and enter into a number of pharmaceutical preparations.

E. Cardamomum medium is a native of the hilly country in the neighbourhood of Sytheh, where the plant is called Do Keswa. The seeds of this species are numerous, obovate, with a groove on one side. Dr. Lindley concludes that this plant yields the *Cardamomum medium* of writers on Materia Medica.

ELEUSINE, a genus of Plants belonging to the natural order of the Grasses. *E. coracana* is cultivated as a corn-plant by the inhabitants of the Coromandel Coast, and is known by the name of Natchuee. According to Schomburg a decoction of another species, *E. Indica*, is employed in Demerara in the convulsions of infants. *E. Tocusso* is an Abyssinian corn-plant belonging to this genus.

ELEUTHERIA. [CROTON.]

ELIDONE. [SEPIADÆ.]

ELK. [CERVIDÆ.]

ELLIPSOLITHES. Mr. Sowerby gave this title to some (compressed?) forms of Fossil *Cephalopoda*, from the Mountain Limestone.

ELLIPSOSTO'MATA, De Blainville's name for a family (the third) of his second order, *Asiphonobranchiata*, of his first sub-class, *Paracephalephora Dioica*, of his second class, *Paracephalophora*, of his *Malacozoa*. The *Ellipsostomata* of De Blainville comprehend the genera *Melania*, *Rissoa*, *Phasianella*, *Ampullaria*, *Helicina* (including *Ampullacera*, De Blainv., and *Olygira*, Say), and *Pleurocerus*. Of these all but *Pleurocerus* are included under the Pectinibranchiate Gasteropods of Cuvier; and as the habits of the included genera are by no means uniform, the genera will be treated of under their several titles. [AMPULLARIA.]

ELM. [ULMUS.]

ELODIANS. [CHELONIA.]

E'LYMUS, a genus of Grasses belonging to the tribe *Hordeineæ*. It has 2 glumes, both on the same side of the spikelet, without awns or setæ, with 2 or more perfect flowers, and the spikelets two or three together. Several species of this genus have been described. Two only are natives of Great Britain.

E. arenarius, Upright Lyme-Grass. It has an upright close spike; the rachis flat, not winged; the glumes lanceolate, downy, not longer than the spikelets. It is a coarse grass, common on sandy sea-shores; and, with other grasses, it sends down long fibrous roots amongst the sand in such a way as to prevent its moving about with the winds. On some parts of the coast immense sandbanks are formed by this grass and others, binding down the sands which are thrown up by occasional and successive high tides. Although this grass, according to Sir H. Davy, yields a large quantity of sugar, it is not eaten by any of our domestic animals.

E. geniculatus, Pendulous Lyme-Grass, has a lax spike bent downwards; the rachis winged; the glumes awl-shaped, glabrous, longer than the spikelets. The stem is 3 or 4 feet high, and the spike 1 or 2 feet long, bent down in a remarkable manner at the second or third spikelet. It has been found near Gravesend. Most of the remaining species are natives of America, both North and South.

(Babington, *Manual of British Botany*; Loudon, *Encyclopædia of Plants*.)

ELYSIA. [PLACOBRANCHIATA.]

ELYSIADÆ. [NUDIBRANCHIATA.]

ELZERINA. [CELLARIÆA.]

EMARGINULA. [FISSURELLIDÆ.]

EMBERIZA. [EMBERIZIDÆ.]

EMBERIZIDÆ, a family of Birds belonging to the order *Insessores* and the tribe *Conirostres*. The most distinguishing genus of the family is *Emberiza*. It comprises however other genera. The general relations of this family are given under FRINGILLIDÆ. We shall confine ourselves here to the British genera of this family known under the name of Buntings.

Plectrophanes.—Beak short, thick, conical, the edges of both mandibles slightly curved inwards; upper mandible smaller than the lower, with a small palatal knot. Nostrils basal, oval, partly hidden by small feathers. Wings long and pointed; the first and second quill-feathers of nearly equal length, and the longest in the wing. Legs with the tarsi of moderate length; anterior toes divided; lateral toes equal in length; hind toe strong; claw elongated, and nearly straight.

P. Lapponica (Gould), the Lapland Bunting. It is the *Emberiza Lapponica* and *E. calcarata* of other writers. Though a native of the arctic regions, Mr. Yarrell records five instances of its being taken in Great Britain. It is found in Siberia and near the Uralian chain. Towards winter a few migrate as far as Switzerland. It inhabits the Faroe Islands, Spitzbergen, Greenland, and Iceland in summer, and thence westward to Hudson's Bay. Sir John Richardson says, that about the middle of May, 1827, it appeared in very large flocks at Carlton House, and a few days later made their appearance at Cumberland House. The eggs are usually seven, and of a pale ochre-yellow spotted with brown.

P. nivalis, the Snow-Bunting. It is the *Emberiza glacialis*, *E. montana*, *E. nivalis*, and *E. mustelina* of authors; and the Tawny-Mountain- and Snow-Bunting of English writers. It was at one time supposed they were different species, but this arose from the great variety of plumage to which these birds are subject. The predominant colour of their plumage is white, hence the name Snow-Bunting. This bird arrives in this country in the end of September and the beginning of October, and extends from the north of Scotland to the south of England. This bird is rather larger than the last.

Emberiza.—Beak conical, strong, hard, and sharp-pointed; the edges of both mandibles curving inwards; the upper mandible narrower and smaller than the under one, and its roof furnished with a hard bony and projecting palatal knob. Nostrils basal and round, partly hidden by small feathers at the base of the bill. Wings of moderate size; the first quill shorter than the third, which is the longest in the wing. Feet with three toes before and one behind, divided to their origin; claws rather long, curved, and strong.

E. miliaria, the Common Bunting, is the most common species of this genus. It remains in the British Islands throughout the year; and on account of its very familiar presence in corn-fields, is frequently called the Corn-Bunting. It builds its nest in April, and lays four or five eggs of a reddish-white or pale purple-red ground, streaked and spotted with dark purple-brown. It feeds on the seeds of the grasses, of the *Polygona*, of sorrels, and of cereal plants; also on Coleopterous Insects.

In both sexes of this species the upper parts are of a light yellowish-brown streaked with blackish-brown, each feather being of that colour along the shaft; lower parts pale yellowish-gray, each feather of the fore neck tipped with a triangular spot of brownish-black, the fore part of the breast and the sides with more elongated and fainter spots.

E. schœniclus, the Reed-Bunting. It is also called, according to MacGillivray, Black-Headed Bunting, Reed-Sparrow, Water-Sparrow, Ring-Bunting, Ring-Bird, Ring-Fowl, and Chuck. It frequents marshy places, where it is seen perching on willows, reeds, sedge, and other aquatic plants. It feeds on insects, seeds, and small *Mollusca*. The nest is placed among aquatic plants, and is composed of stalks and blades of grasses, bits of rushes, and the like. The eggs are four or five in number, of a yellowish-gray, with tortuous or angular lines, and irregular spots of black. This bird is easily distinguished from the other species by its black head and white throat.

E. citrinella, the Yellow Bunting, or Yellow Ammer. It is also called in English Yellow Yelding or Yolding, Yellow Yowley, Yellow Yite, Yeldrock Skute, and Devil's Bird. It is a permanent resident in Great Britain, in cultivated and wooded districts, where it is well known. The back and wings are bright red, the central part of each feather brownish-black. The nest is composed of coarse grasses and twigs, neatly lined with fine grass, fibrous roots, and hairs: it is placed on the ground or in the lower part of a bush. It lays four or five eggs purplish-white, marked with linear and angular streaks and a few irregular dots of black.

E. Cirlus, the Cirl-Bunting. This bird is not so common in this country as the last, which it greatly resembles. It was first distinguished as a British bird by Colonel Montague. It is a native also of the south of Europe, and is more frequent in the south of England than in the north.

E. hortulana, the Ortolan Bunting. A very few specimens only of this bird have been taken in England. It is common in the southern countries of Europe, and migrates as far northward as the Baltic.

(MacGillivray, *Manual of British Birds*; Yarrell, *History of British Birds*.)

E'MBLICA, a genus of Plants belonging to the natural order *Euphorbiaceæ*. It has monœcious flowers; the calyx 6-parted; 3 stamens combined; 3 styles dichotomous; the fruit fleshy, tricoccous, 6-seeded.

E. officinalis is a native of most parts of India. It is a tree having a crooked trunk, with branches thinly scattered in every direction; the male branches spreading and drooping. The leaves are alternate, spreading, one or two feet long, and about one and a half or two inches broad: the stipules small, withering; the flowers minute, of a greenish colour; the fruit a drupe, fleshy, globular, smooth, 6-striated: the nut obovate, obtusely triangular, 3-celled; the seeds two in each cell. The bark of this tree is astringent, and is used in India as a remedy for diarrhœa. The fruit is acid, and tastes astringent, and when eaten acts as a mild purgative. This plant is the *Phyllanthus Emblica* of Linnæus; and *Myrobalanus Emblica* of Bauhin.

(Lindley, *Flora Medica*.)

EMBRYO. [REPRODUCTION IN ANIMALS; REPRODUCTION IN PLANTS; SEED.]

EMERALD. [BERYL.]

EMERITA. [HIPPA.]

EMERY. [ADAMANTINE SPAR; CORUNDUM.]

EMMET, a name used by early English writers for the Ant. [FORMICA.]

EMPALEMENT, an obsolete name for the stamen of a flower.

EMPEROR-MOTH. [SATURNIA.]

EMPETRA'CEÆ, *Crowberries*, a small natural order of Polypetalous Exogenous Plants, related to *Euphorbiaceæ*. They consist of unisexual heath-like plants with minute flowers, having a calyx with a few imbricated sepals that change into about three membranous petals, a small number of hypogynous stamens, and a superior ovary with from 3 to 9 cells, in each of which there is a single ascending ovule. The fruit is fleshy and berried. They are small acrid plants, of no known use, and comprise a few species from the north and south of Europe, North America, and the Straits of Magalhaens. *Empetrum nigrum*, the Crakeberry or Crowberry, is wild on the mountainous heaths in the north of England. Its black fruit forms an article of food in the northern parts of the world, but is reported to be unwholesome, and to cause headache. A sort of wine has been prepared from it for many centuries in Iceland and Norway; whence the report of real wine which was used at the sacrament being made in those countries.

The white berries of the *Camarinheira* (*Corema*) are employed by the Portuguese in making an acidulous beverage, which the domestic physicians esteem in fevers.

There are 4 genera and 4 species of this order.

EMPETRUM. [EMPETRACEÆ.]

Empetrum rubrum.

1, a female flower, much magnified; 2, a pistil; 3, a transverse section of the same.

EMU. [STRUTHIONIDÆ.]

EMYS. [CHELONIA.]

EMYSAURA. [CHELONIA.]

ENALIOSAURA, a name proposed for the great Fossil Marine Lizards represented by *Ichthyosaurus* and *Plesiosaurus*. [ICHTHYOSAURUS; PLESIOSAURUS; REPTILES.]

ENAMEL. [TEETH; DENTITION.]

ENCELADITE, a Mineral containing Titanium, a variety of *Warwickite*. [WARWICKITE.]

ENCEPHALARTOS, a genus of Plants belonging to the natural order *Cycadaceæ*. The species are found in Africa. Like many of the other forms of Cycadaceous Plants they yield starch in their stems, which are prepared by the natives and eaten; hence these plants are known by the name of Caffer-Bread or Kaffir-Bread.

ENCHANTER'S NIGHT-SHADE. [CIRCÆA.]

ENCHELIS, a genus of Infusorial Animalcules. The species *E. sanguinea* and *E. pulvisculus*, according to Meyen, form the Red and Green Snow-Plants which have been described as *Confervæ*, and referred to *Protococcus*. [SNOW, RED.]

EN'CHODUS, a genus of Fossil Cycloid Fishes, from the Chalk. (Agassiz.)

ENCRINITES, the name by which the petrified radiated animals commonly called Stone Lilies have been long known in Britain: it is also applied generally to the *Crinoidea*, a family of Animals belonging to the order *Echinodermata*. [ECHINODERMATA.]

Lamarck arranged the genus *Encrinus* in his fifth order of Polypes (*Polypi natantes*), fixing its position between *Virgularia* and *Umbellularia*, and recording but two species, one recent, namely *Encrinus Caput-Medusæ* (*Isis Asteria*, Linn.), from the seas of the Antilles; the other fossil, namely *E. liliiformis* (*Lilium lapideum*, Stone-Lily of Ellis and others).

Cuvier includes the Encrinites among his Pedicillated Echinoderms, considering that they should be placed near the *Comatulæ*; and in the 'Règne Animal' they are accordingly to be found between the great group of the Star-Fishes and that of the Echinideans.

De Blainville observes that the beautiful work of Guettard ('Acad. des Sc.' 1755) upon the living and fossil Encrinites, showed long ago the great relationship which there is between these and the *Comatulæ*, and he remarks upon the arrangement of Lamarck, who followed Linnæus and his adherents in placing them among the Zoophytes, notwithstanding Guettard's exposition and Ellis's confirmation. After alluding to Miller's work on the family, and to Mr. Thompson's description of the living specimen found on the coast of Ireland, De Blainville takes as the basis of his terminology the parts which exist in *Comatulæ*, and, adopting the views of Rosinus, rejects that proposed by Miller in his interesting memoir, objecting to the terms 'pelvis,' 'costal,' 'intercostal,' 'scapula,' 'hand,' 'fingers,' &c., as derived from animals of an entirely different type of form, and inapplicable to the radiated structure.

We find, then, that the 'pelvis' of Miller is the centro-dorsal joint (l'article centro-dorsal) of De Blainville. The 'costal' is the first basilary joint of each ray. The 'intercostal' is the second basilary joint. The 'scapula' is the third, or that on which the radii are supported. The 'hand' is the part of the ray which is divided but not separated. The 'fingers' are the digitations or divisions of the rays. Finally, the 'pinnules' are the lateral divisions of the digitations; and De Blainville, like Miller, divides the rays into principal rays and accessory or auxiliary rays.*

Dr. Buckland ('Bridgewater Treatise'), who uses the phraseology of Miller, speaks of these animals as destined to find their nourishment by spreading their nets and moving their bodies through a limited space, from a fixed position at the bottom of the sea; or by employing the same instruments, either when floating singly through the water, or attached, like *Pentelasmis* [CIRRIPEDIA], to floating pieces of wood. He refers to Miller for several instances of their power of repairing casual injuries, and figures a recent *Pentacrinus*, one of whose arms is under the process of being reproduced, as crabs and lobsters reproduce their lost claws and legs, and many lizards their tails and feet, observing that the arms of star-fishes also, when broken off, are in the same manner reproduced. [ECHINODERMATA.] The same author remarks, that although the representatives of the Crinoideans in our modern seas are of rare occurrence, this family was of vast numerical importance among the earliest inhabitants of the ancient deep. "We may judge," says Dr. Buckland, "of the degree to which the individuals of these species multiplied among the first inhabitants of the sea, from the countless myriads of their petrified remains which fill so many limestone beds of the transition formations, and compose vast strata of entrochal marble, extending over large tracts of country in Northern Europe and North America. The substance of this marble is often almost as entirely made up of the petrified bones of Encrinites as a corn-rick is composed of straws. Man applies it to construct his palace and adorn his sepulchre; but there are few who know, and fewer still who duly appreciate, the surprising fact, that much of this marble is composed of the skeletons of millions of organised beings, once endowed with life, and susceptible of enjoyment, which, after performing the part that was for a while assigned to them in living nature, have contributed their remains towards the composition of the mountain masses of the earth. Of more than thirty species of Crinoideans that prevailed to such enormous extent in the transition period, nearly all became extinct before the deposition of the lias, and only one presents the angular column of the Pentacrinite: with this one exception, pentangular columns first began to abound among the Crinoideans at the commencement of the lias, and have from thence extended onwards into our present seas. Their several species and even genera are also limited in their extent; for example, the great Lily Encrinite (*E. moniliformis*) is peculiar to the Muschel-Kalk, and the Pear-Encrinite to the middle region of the Oolitic Formation."

The same author, speaking of the joints which composed the stem, says, "The name of Entrochi, or Wheelstones, has with much propriety been applied to these insulated vertebræ. The perforations in the centre of these joints affording a facility for stringing them as beads, has caused them in ancient times to be used as rosaries. In the northern parts of England they still retain the appellation of 'Saint Cuthbert's beads.'

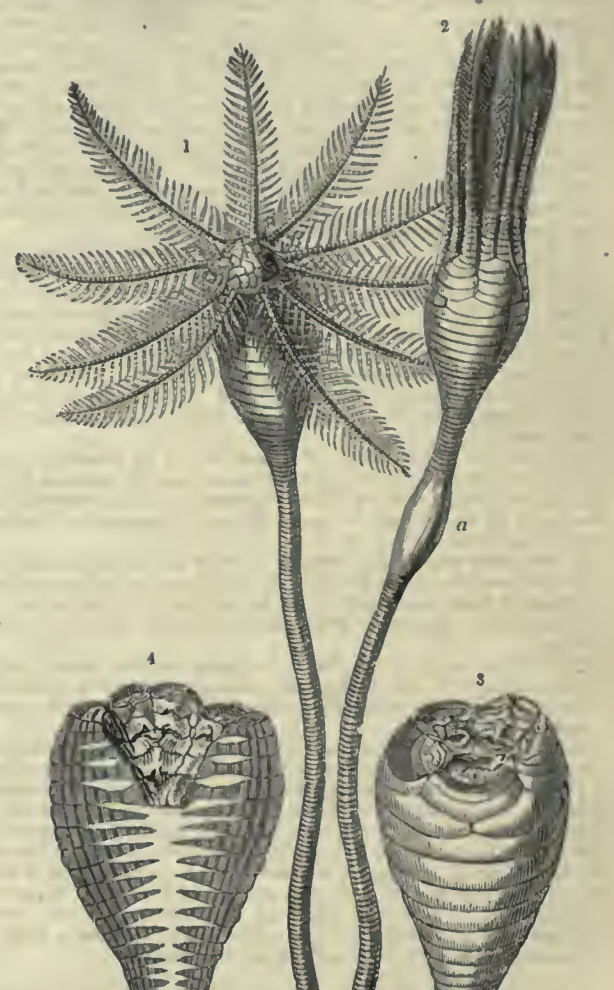
> On a rock by Lindisfarn
> Saint Cuthbert sits, and toils to frame
> The sea-born beads that bear his name.

"Each of these presents a similar series of articulations, varying as we ascend upwards through the body of the animal, every joint being exactly adjusted to give the requisite amount of flexibility and strength. From one extremity of the vertebral column to the other, and throughout the hands and fingers, the surface of each bone articulates with that adjacent to it, with the most perfect regularity and nicety of adjustment. So exact and methodical is this arrangement, even to the extremity of its minutest tentacula, that it is just as improbable that the metals which compose the wheels of a chronometer should for themselves have calculated and arranged the form and number of the teeth of each respective wheel, and that these wheels should have placed themselves in the precise position fitted to attain the end resulting from the combined action of them all, as for the successive hundreds and thousands of little bones that compose an Encrinite to have arranged themselves in a position subordinate to the end produced by the combined effect of their united mechanism, each acting its peculiar part in harmonious subordination to the rest; and all conjointly producing a result which no single series of them acting separately could possibly have effected." ('Bridgewater Treatise.')

De Blainville characterises his Fixed Asterencrinideans (Astérencrinides Fixés) as having a body more or less bursiform, supported upon a long articulated stem, and fixed by a radiciform part.

Genus, *Apiocrinites*.—Miller, who established this genus, characterises it as an animal with a column gradually enlarging at the apex, composed of numerous joints, of which the superior is marked by five diverging ridges, dividing the surface into as many equal portions, sustaining the pelvis, formed of five sub-cuneiform joints, supporting others of a figure nearly similar, from which proceed the arms and tentaculated fingers formed of simple joints having the figure of a horse-shoe.

De Blainville thus defines it:—Body regular, circular, for the rest unknown, contained in a sort of cupule or conical test (têt), composed of three superposed rows, each consisting of five scaphoid plates, united or jointed throughout, the upper one supporting on a radiated surface the rays which are formed by a simple series of non-pinnated (?) articulations. Stem round, at first as large as the body, attenuating by degrees down to the root; articulations circular,



Bradford Pear-Encrinite (*Apiocrinites rotundus*), restored and reduced.

1, expanded; 2, closed; *a*, the remedial effect of calcareous secretions in repairing an injury of the joints of the stem: two young individuals, and the surfaces of two truncated stems appear at the base; 3, pear-shaped body of *Apiocrinites rotundus*, showing at its upper extremity the internal disposition of the bones surrounding the cavity of the stomach; 4, vertical section of the body, showing the cavity of the stomach, and a series of lower cavities, or hollow lenticular spaces, between the central portions of the enlarged joints of the upper portion of the vertebral column. These spaces are considered by Miller as enlargements of the alimentary canal, which descends through the axis of the entire column. The surfaces of the joints of the vertebral column are striated with rays on the adjacent plates, and allow of flexure without risk of dislocation. (Buckland.)

* It is necessary to put the student on his guard against the confusion and error manifest in this part of De Blainville's useful work. This was not a little puzzling when considered as coming from a pen of such high reputation as his; till the arrival of the 'Nouvelles Additions et Corrections' brought the information that "par une transposition singulière du manuscrit, il y a eu une sorte de mélange entre les paragraphes qui appartiennent aux genres *Encrinus* et *Pentacrinus*." In short, among other mistakes, the titles *Encrinus* and *Pentacrinus*, together with whole paragraphs, have been misplaced.

little elevated, pierced by a round hole, and radiated at their surface. Auxiliary rays scattered. This genus has occurred hitherto in a fossil state only, and has alone been found in strata posterior to the Lias.

A. rotundus, Round-Columned, Pear-like, Lily-shaped Animal (Miller). It appears to be the *Astiopoda elegans* (stem) of Defrance. It is the Bradford Pear-Encrinite of Parkinson, and is described by Miller as a crinoidal animal, with a round column, composed of joints adhering by radiating surfaces, of which from 10 to 14 gradually enlarge at its apex, sustaining the pelvis, costæ, and scapulæ, from which the arms and tentaculated fingers proceed. Base formed by exuding calcareous matter, which indurates in laminæ, and permanently attaches the animal to extraneous bodies.

It occurs in the middle region of the Oolite at Bradford in Wiltshire, Abbotsbury, near Weymouth, Dorsetshire, Soissons, Rochelle, &c.

Miller describes and figures a second species, *Apiocrinites ellipticus* (Bottle-Encrinite, Strait-Encrinite, and Stag-Horn Encrinite of Parkinson; Goldfuss refers to it as *A. elongatus*), and gives the Chalk-Pits of Wiltshire and Kent as its localities. The bodies, &c. of this species are the Chalk-Bottles of the quarrymen.

M. Goldfuss, in his great work, records four additional species, namely, *A. rosaceus*, *A. mespiliformis*, and *A. Milleri* (Schlotheim), and *A. flexuosus*, and *A. obconicus* Goldfuss), retaining Miller's *A. ellipticus*, and referring to Miller's description of that species for *A. elongatus* also.

Encrinus (*Encrinites*, True Lily-shaped Animal of Miller.)—Miller characterises his genus *Encrinites* as a crinoidal animal, with a column formed of numerous round depressed joints, adhering by a radiating grooved surface, and becoming subpentangular near the pelvis, which is composed of five pieces, giving a lateral insertion to the first series of costal plates, to which the second series and scapulæ succeed, whence the tentaculated arms or fingers proceed, formed by double series of joints. He observes that the animals of this genus have not hitherto been found in a living state, nor does he believe that their remains have been discovered in England.

E. liliiformis, Lamarck. This is the *E. moniliformis*, Bead-columned, True Lily-shaped Animal of Miller, who describes the species as a crinoidal animal, with a column formed of numerous round joints, alternately, as they approach the pelvis, larger and smaller, becoming subpentangular when nearly in contact with it. On the pelvis, formed of five pieces, adhere laterally the first series of costæ, on which the second series of costæ is placed, succeeded by the scapulæ, from which the ten tentaculated arms or fingers proceed. Animal permanently affixed by exuded indurated matter.

Lily-Shaped Encrinite (*Encrinus liliiformis*).

Miller's *E. moniliformis* is probably the *E. liliiformis* of Lamarck, the Encrine and Lys de Mer of the French, the *Lilium lapideum* of some of the older writers, and the Stone Lily of the English. It is found in the Muschel-Kalk, Hildesheim, Rakenberg near Goslar, Obernscheden and Azzenhausen, not far from Gemenden, in Lower Saxony; Sewerven in Juliers, in Westphalia; the village of Erkerode in Brunswick, about two miles from the town bearing this name, near a wood called the Elm, &c. In this last-named locality the quarry is on the declivity of a hill overgrown with wood, on which account the inhabitants oppose the digging after them. The stratum containing them is hardly fifteen to eighteen inches in thickness. Under the surface of the earth is a friable, porous, argillaceous limestoue, containing millions of columns and columnar joints; but many hours' digging is necessary before a good specimen of the superior part, or stone-lily, can be procured since the moisture in the stone contributes to their rapid destruction, and their occurring on large pieces of stone makes them liable to separation, which accounts for the many mended specimens. Another and harder stratum under the above contains numerous crinoidal remains; but, according to the quarrymen, no stone-lilies. (Miller.) The author last quoted adds that there is good reason to believe that the formation in which the remains are found near Brunswick corresponds with the White Lias of England, as it appears to repose on the newer Red-Sandstone containing salt and gypsum.

Fine specimens of this fossil have always been and still are sought for with great eagerness by collectors. In the 'Beyträge zur Naturgeschichte,' Altenburg, 1774, it is stated that the Emperor of Germany offered 100 dollars for a stone-lily free from the matrix, and attached to its column.

"The peculiarly fine lily encrinite," writes Miller, "figured by Knorr, tab. 11, *a*, was, it is said, purchased ('Naturforscher,' Stück 3) from the labourers at the limestone quarry at Schrapland, near Halle, by Inspector Wilkens, for thirty-two groschen, and given to Professor Lange, who sold it to Baron Niegart. However in the same publication (Stück 6), it is stated that it was not bought by Wilkens, but by Mr. Vitigo, at Farrenstadt, near Querfurt, for two dollars, and given to Lange, who sold it for three louis d'or. If my memory does not misgive me, I think I saw the specimen about twenty years ago in the collection of the Naturforschenden Gesellschaft, at Danzig. Where is it now?"

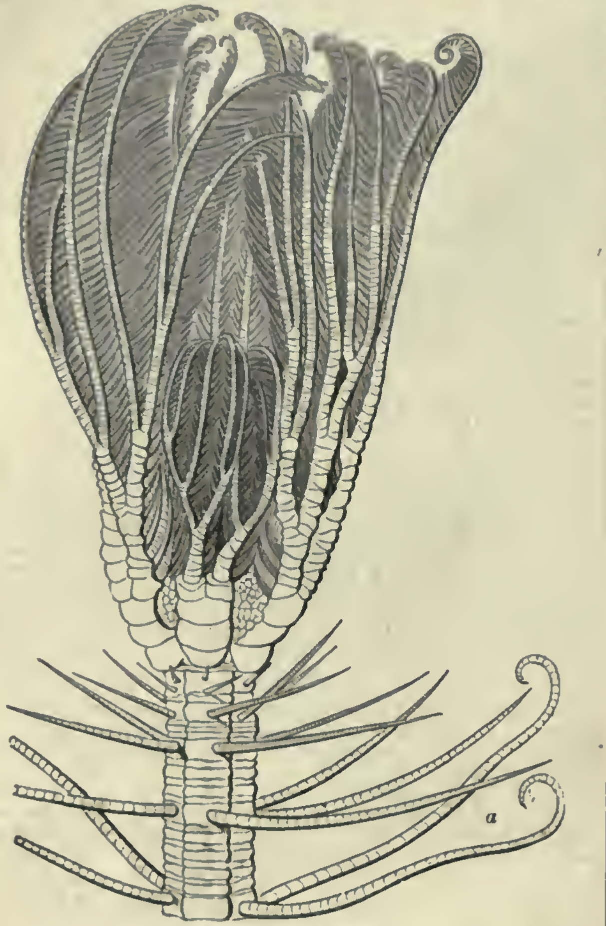
Pentacrinus (*Pentacrinites* vel *Pentacrinus*, Five-Angled Lily-shaped Animal, Miller; *Pentagonites Rafinesque*).—The following is the generic character as given by Miller:—An animal with a column formed of numerous pentangular joints, articulating by surfaces with pentapetalous semistriated markings. Superior columnar joint supporting a pelvis of five joints, on which five first costals rest, succeeded by five second costals and five scapulæ, from which ten arms proceed, having each two hands, composed of several tentaculated fingers. Column long, having numerous auxiliary side-arms. Base not ascertained.

* *Recent Species.*

P. Caput-Medusæ is a crinoidal animal having a column formed of numerous pentangular joints, articulating by surfaces with pentapetalous ovate striated markings; five auxiliary side-arms formed of round joints proceeding from the column at intervals. Superior columnar joints supporting a pelvis of five plates, to which the first costals, second costals, and scapulæ succeed, from which ten arms proceed, each supporting two hands, subdividing into three fingers. Lower extremity, or base, unknown. (Miller.)

It is the *Encrinus Caput-Medusæ* of Lamarck; *Isis Asteria* of Linnæus. It inhabits the seas of the Antilles, and has been taken near the island of Barbadoes (Dr. Hunter's specimen), also off Nevis (specimen formerly belonging to James Tobin, Esq., now in the British Museum), and Martinique (specimen in the Paris Museum). There is also a specimen in the Museum of the Royal College of Surgeons in London, and one in that of the Geological Society of London.

Mr. Miller, in speaking of Mr. Tobin's specimen, says, "In the drawing it up from the bottom of the sea, the animal has clearly been broken off, leaving its posterior portion behind; thus we have lost the chance of ascertaining the fact, whether it adhered by a fixed base, or had a locomotive power. The same accident has befallen the other recent individuals that have been mentioned when speaking of the locality of this species. However, judging from its analogy to the *Encrinus moniliformis*, from its long column, numerous auxiliary side-arms, and the associated manner in which groups of the following species are sometimes found preserved on the surface of a single slab, with the columns all tending towards the same point, as if issuing from a common base, I conceive that this species also adhered by a base to extraneous matter. This idea gains some further ground, from all the recent specimens hitherto found having broken abruptly off in the endeavour to remove them, as not being able to free themselves from the points of adhesion, which certainly would have been the case had the animal possessed a locomotive power." This inference acquires additional confirmation from the observations made by the late J. Tobin, Esq., on another specimen, namely—"Some years ago I was in possession of a larger Pentacrinite, which was brought to me so fresh out of the sea that at the bottom (where it plainly appeared to have been broken off from the rock to which it was fixed) the blood was actually oozing from the vertebræ. This specimen I endeavoured to preserve, but it was totally destroyed by the ants, who ate every cartilage, so that it fell to pieces." Miller observes upon this, that the 'blood' was the fluid in the alimentary canal, and refusing to admit the assertion of Walch, that the Pentacrinite is an animal crawling along the bottom of the sea, conceives it to have generally stood more or less erect in the sea, yielding to the fury of the storm in bending down, and adhering for additional security with its side-arms to extraneous matter, or closing them to the column, and thus offering the least surface possible to the element. The latter, he thinks, is the most probable idea, since he had frequently met with specimens in that state, but had never seen any side-arms clasping round extraneous matter. The author elsewhere states that he has in vain endeavoured to trace apertures at the terminating points of the fingers and tentacula, although Guettard alleges that here orifices existed serving as mouths to the animal in taking its food.



Pentacrinus Caput-Medusæ.

In the front of the figure two of the arms are much smaller than the others, showing that the animal had suffered mutilation, and had employed its power of reproducing the lost parts. *a*, The auxiliary side-arms, articulating at distant intervals with the vertebral column, capable also of being reproduced. (Miller and Buckland.)

Miller observes that columnar fragments, smaller and rather neater than those of this species, occur in the Oolite at Dundry, the Forest Marble at Chippenham, and the Chalk near Lyme, but that it remains to be ascertained, by the acquisition of perfect specimens, whether these belong to a variety of *P. Caput-Medusæ*, or possess peculiar characters sufficient to distinguish them as a new species.

The only living British species of animal representing this family is the *Comatula rosacea*. [COMATULA.] The young of this animal was formerly called *Pentacrinus Europæus*.

** *Fossil Species.*

P. Briareus, the Briarean Pentacriuite, may be taken as an example. It is thus characterised by Miller:—"A crinoidal animal, having a large column formed of numerous pentagonal joints, alternately larger and smaller, articulating by surfaces with pentapetalous compressed semistriated markings; five auxiliary arms, formed of much compressed suboval joints, proceeding at intervals from the column; five joints of the pelvis, supporting first five and second five costal joints, on which the scapulæ affix, from which ten arms proceed, each having two hands, formed of numerous fingers, sometimes amounting to sixteen."

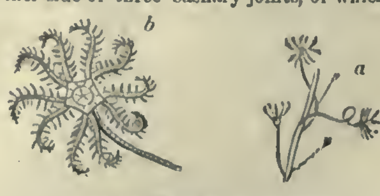
Dr. Buckland observes that the root of the Briarean Pentacrinite was probably slight, and capable of being withdrawn from its attachment. The absence of any large solid secretions like those of the Pear-Encrinite, by which this Pentacrinite could have been fixed permanently at the bottom, and the further fact of its being frequently found in contact with masses of drifted wood converted into jet, leads him to infer that the Briarean Pentacrinite was a locomotive animal, having the power of attaching itself temporarily either to extraneous floating bodies or to rocks at the bottom of the sea, either by its side-arms or by a moveable articulated small root. We confess that we cannot entirely concur with the Professor on this point. That in early youth the animal may have floated till it found a substance fit for it to adhere to, we do not deny; but we think that after it was once established and had attained a good size, it was fixed for ever. The great length of the stem and the numerous side-arms must have secured for it a field of action beyond that of the Pear-Encrinite and the Lily-Encrinite, both of which we know had permanent roots; and if we are to judge by analogy, there is pregnant evidence that the specimens of the living species, more especially the larger one mentioned by Mr. Tobin, who saw it quite fresh out of the sea, and to whose expressions above given we refer the reader, suffered their stems to be torn asunder without quitting their moorings.

It is found in the lower strata of the Oolite Formation, especially the Lias: Lyme, Watchet, Keynsham, &c.

Mr. Miller gives three other fossil species, namely *P. subangularis*, *P. basaltiformis*, and *P. tuberculatus*. Goldfuss has recorded the following additional species, namely *P. scalaris* (Goldfuss), *P. cingulatus* (Münster), *P. pentagonalis* (Goldfuss), *P. moniliformis* (Münster), *P. subsulcatus* (Münster), *P. subteres* (Münster), *P. dubius* (Goldfuss), and *P. priscus* (Goldfuss), and, with a note of interrogation, *Pentacrinus* (?) *paradoxus*.

a, *Pentacrinus Briareus* reduced (Lyme); *b*, rare and beautiful specimen of Briarean Pentacrinite (natural size), from the Lias at Lyme Regis, in the collection of Mr. Johnson, of Bristol, showing the plated integument of the abdominal cavity, terminated upwards by a flexible proboscis, and surrounded by the commencement of the arms and fingers. (Figures and description from Dr. Buckland's 'Bridgewater Treatise.')

Phytocrinus, De Blainville (*Hibernula*, Fleming; *Pentacrinus*, Thompson).—Body regular, circular, covered and surrounded above by a sort of solid cupule, composed of a centro-dorsal undivided piece, round which are articulated, first, a single row of accessory unguiculated rays, then another row of great didymous and pinnated rays on the other side of three basilary joints, of which the first only



Pentacrinus Europæus of Thompson.

a, several individuals in different stages of development adhering by the base of an articulated column to the stem of a coralline; *b*, one of the individuals expanded and magnified.

partially touch each other. Stem articulated, round, and without accessory rays. Mouth central in the midst of five scales, which are foliaceous and bordered by a row of tentacular cirrhi; a large tubular orifice a little behind the mouth.

P. Europæus, *Pentacrinus Europæus*, Thompson. It is now generally admitted that the observations of Mr. J. V. Thompson have proved that this animal is but the young of *Comatula*. If no other species of *Phytocrinus* be found, this genus must be cancelled.

Poteriocrinites.—A crinoidal animal, with a round column, composed of numerous thin joints, having in their centre a round alimentary canal, and articulating by surfaces striated in radii. Round auxiliary side-arms proceeding at irregular distances from the column. Pelvis formed of five pentagonal plate-like joints, supporting five hexagonal intercostal plate-like joints, and five plate-like scapulæ, having on one of the intercostals an interscapulary plate interposed. An arm proceeding from each of the scapulæ. Base probably fascicular, and permanently adhering. (Miller.)

The author of this generic character says, "It is with considerable hesitation that I describe these five plates as belonging to the pelvis; the analogy of their lower articulating surfaces seems perhaps rather to indicate their belonging to the first costal series. I have never yet had an opportunity of seeing the connection of these plates with the first column or joint fairly developed, and it seems possible that the true pelvis may be small and almost concealed. This doubt will be done away by the acquisition of more instructive specimens, and my thus stating the case must be considered as resulting from an anxious desire to check errors. It is not unlikely that the real joints forming the pelvis are so much abbreviated as not to be visible externally. Every one acquainted with fossils must be aware how difficult it is to trace always organic details in them correctly, and how many specimens are sometimes necessary to ascertain a single fact."

De Blainville observes that this genus does not appear to differ from *Apiocrinites*, excepting inasmuch as that the stem is not enlarged at its superior part, and that the basilary pieces of the rays are less approximated, and without doubt less immoveable. The details given by Mr. Miller point out a form differing strongly from that of *Apiocrinites*, and if his data be admitted there can be little doubt of the generic difference which he records.

P. tenuis, Thin, Vase-like, Lily-shaped Animal. A crinoidal animal, with a column formed of numerous round thin joints, surface of articulation radiating and striated. The plate-like joints forming the cup-like body, articulating by minute striæ. One arm proceeding from each scapula, supporting two fingers. It is found in the Mountain Limestone of the Mendip Hills and in the Black Rock, the 14th bed of Dr. Bright's series ('Geol. Trans.,' vol. iv. p. 193), near the river Avon, Bristol, belonging to the same formation. (Miller.)

The other species recorded by Miller is *Poteriocrinites crassus*, from the Mountain Limestone in Yorkshire, and the Mountain Limestone at Bristol, near the river Avon, bed 1 and 14 of Dr. Bright's paper in 'Trans. of Geol. Soc.,' vol. iv. p. 193, and in the Magnesian beds of the Mountain Limestone, Clevedon Bay, Somersetshire. Miller further states that the specimen mentioned in Dr. Woodward's 'Catalogue of Foreign Fossils' (page 19, 8. 1.) as coming from Syria, is of this species, and that he (Miller) is indebted to the Rev. A. Sedgwick, Woodwardian Professor, Cambridge, for ascertaining this fact, he having kindly furnished Mr. Miller with a drawing made from the original, now in Dr. Woodward's collection, and under his care.

Platycrinites.—A crinoidal animal, with an elliptic or (in one species) pentagonal column, formed of numerous joints, having a few side-arms at irregular distances. Pelvis saucer-shaped, formed of three unequal pieces, from which five large plate-like scapulæ proceed. Base provided with numerous fibres for attachment. Miller, who thus characterises the genus, observes that the want of costæ supplied by the large plate-like scapulæ gives the superior part of these animals a pentagonal appearance, and furnishes so conspicuous a character that they are readily distinguished from all other genera.

P. lævis, Smooth, Broad-Plated, Lily-shaped Animal. A crinoidal animal, with a column formed of very muscular elliptical joints adhering by a transverse ridge. Round side-arms occasionally proceeding from the column, whose joints adhere by radiated surfaces. Pelvis saucer-shaped, with the five scapulæ adhering to it, from each of which an arm proceeds supporting two hands, having each two fingers. Pelvis and scapulæ smooth. Locality in the Mountain Limestone of the Mendip Hills, the Black Rock (14th bed of Dr. Bright's series in 'Geol. Trans.,' vol. iv.) near Bristol; Dublin; Cork. (Miller.)

Miller remarks that he has noticed in the collection of Richard Bright, Esq., of Ham Green, near Bristol, numerous joints, probably appertaining to an animal forming a variety, or a distinct species. They came, he states, from Mnirkirk, in Dumfriesshire; and he adds that the scapulæ are shorter in proportion than those of the former species, and that the columnar joints are finely tuberculated.

The same author records the following species:—*P. rugosus*, from the Mountain Limestone at Caldy Island, on the south coast of Wales, and at the Mendip Hills; *P. tuberculatus*, from the Mountain Limestone strata; *P. granulatus*, from the Mountain Limestone of the Mendip Hills; *P. striatus*, from the Black Rock (14th bed of Dr. Bright's series); and *P. pentangularis*, from the Mountain Limestone of the Mendip Hills, at Weston-super-Mare, Black Rock near Bristol, and at Mitchel-Dean; also occasionally in Transition Limestone of Dinevawr Park, and Dudley.

Goldfuss names and describes two additional species, namely, *P. depressus* and *P. ventricosus*.

Cyathocrinites.—A crinoidal animal, with a round or pentagonal column, formed of numerous joints, having side-arms proceeding irregularly from it. On the summit adheres a saucer-shaped pelvis of five pieces, on which are placed in successive series five costal plates, five scapulæ, and an intervening plate. From each scapula proceeds one arm, having two hands. Locality, Transition and Mountain-Limestone strata. (Miller.)

C. planus.—A crinoidal animal, with a round column formed of numerous depressed joints, articulating by radiating surfaces, and perforated by an alimentary canal, pentagonal near the pelvis, which becomes round further from it. From each of the scapulæ, which rest on the summit of the cup formed by the pelvis and costæ, proceeds an arm supporting two hands, each being provided with two series of fingers. It is found at Clevedon, in the Magnesian beds of the Mountain Limestone; at Wood-Spring, Black Rock (14th bed of Dr. Bright's series), near Bristol. (Miller.)

Miller observes that a specimen had occurred to him where the columnar joints were alternately smaller and larger, but that he was not aware whether it possessed sufficient character to be considered a variety of the former species. The same author records three other species, and Goldfuss has added three more, namely, *C. pinnatus*, *C. geometricus*, and *C. pentagonus*.

Actinocrinites.—A crinoidal animal, with a round column composed of numerous joints, and perforated by a round alimentary canal. At the summit of the column is placed a pelvis formed of three plates, on which five first costals and one irregular costal adhere, which are succeeded by the second costals and intercostals and the scapulæ, from whence five arms proceed, forming two hands with several tentaculated fingers. Round side-arms proceed at irregular distances from the column, which terminates at the base in a fascicular bundle or root of fibres.

A. triacontadactylus, Thirty-Fingered, Radiated, Lily-shaped Animal (Miller); Rock-Plant (Beaumont); Nave Encrinite (Parkinson). A crinoidal animal with a round column formed of many joints, on whose summit is placed a pelvis of three plates supporting five hexagonal and one pentagonal costal plate, on which the second costals, intercostals, and scapulæ in series adhere, the latter sending off five arms, having each two hands provided with three fingers. Column sending off at irregular distances auxiliary side-arms, and terminating at the base in a bundle of fibrous elongations resembling roots. It is found in Mountain Limestone at the villages of Broughton and Stokes in Craven, Yorkshire (Lister, 1674), Mountain Lime formation of the Mendip Hills (Beaumont), and the Black Rock near Bristol. (Miller.) (See Figure in col. 531.)

Miller describes another species, *A. polydactylus*, from the Mountain Limestone of the Mendip Hills and Caldy Island. De Blainville observes that among the five (seven) new species which Goldfuss refers to this genus—namely, *A. granulatus*, *A. tesseracontadactylus*, *A. cingulatus*, *A. muricatus*, *A. nodulosus*, *A. moniliferus*, and *A. tesseratus*—*A. tesseracontadactylus* appears to De Blainville to offer a new combination of the pieces of the test, and even perhaps of the ten rays of the root, each division being dichotomous.

Melocrinites (Goldfuss).—Column smooth, perforated by a smooth or quinquelobate canal. Auxiliary arms . . . Pelvis composed of four articulations or pieces. Primary and secondary costals five hexagonal, alternately placed (sibi invicem impositi). Intercostals five, hexagonal. Scapulæ five, hexagonal, placed upon the costals. Interscapulars four, in the region of the mouth five. Arms five. Mouth at the side of the vertex.

M. hieroglyphicus, Goldfuss. *Melocrinites* with the articulations or pieces of the cup or calyx nodulous. Locality, Mountain Lime. Goldfuss records a second species, namely *M. lævis*.

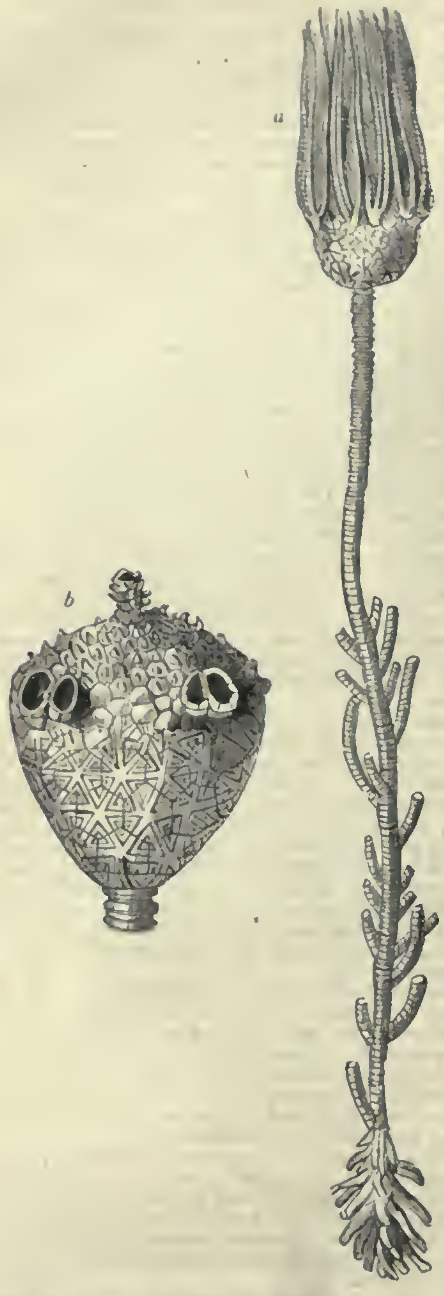
Rhodocrinites (Miller).—A crinoidal animal, with a round and sometimes slightly pentagonal column, formed of numerous joints perforated by a pentapetalous alimentary canal. The pelvis formed of three pieces supporting five square plates, in the spaces of whose lateral bevelled angles five heptagonal first costals are inserted. From the scapulæ proceeds an arm supporting two hands. (Miller.)

R. verus, True Rose-like Lily-shaped Animal. Locality, upper bed, No. 1, and one of the lower beds, No. 15, of Dr. Bright's series, distinguishing the Mountain Limestone formation along the river Avon, near Bristol, the Mendip Hills, Mitchel-Dean, the Transition Limestone at Dudley. (Miller.)

Goldfuss adds four species, namely, *R. gyratus*, *R. quinquepartitus*, *R. canaliculatus*, and *R. echinatus*, the last being *Encrinus echinatus* of Schlotheim.

Eugeniacrinites (Miller).—Superior columnar joint subpentangular, enlarging above, having the five plates of the pelvis adhering to it by a solid anchylosis. Base, column, joints resting on the pelvis, and fingers, unknown. (Miller.)

E. quinquangularis (Miller); Clove Encrinite of Parkinson; *Caryophyllus lapideus*, Caryophyllite of Knorr. Found in Switzerland, at Mount Randen (Knorr); also in the canton Zurich and Schaffhausen. (Miller.) Goldfuss records the following additional species, namely



a, *Actinocrinites triacontadactylus* (reduced); *b*, body of the same (natural size). (Miller and Buckland.)

E. caryophyllatus, *E. nutans*, *E. compressus*, *E. pyriformis*. *E. moniliformis*, and *E. Hoferi*. (Münster.)

Solanocrinites (Goldfuss).—Column very short, pentagonal, perforated by a pentagonal canal, radiato-rugose at the base, depressed or hollowed out at the sides by the glenoid cavities of the auxiliary arms, articulated with the pelvis by slightly prominent rays which are trochitic and coadnnate. Pelvis with five articulations. Scapulæ, arms (?). Auxiliary arms of the column thick and close-set. (Goldfuss.)

S. costatus (Goldfuss), with a turbinated column, 10 or 15-ribbed longitudinally; articulations of the pelvis linear. Silicified. It is found at Würtemberg in Jurassic Limestone. (Goldfuss).

M. Goldfuss describes two other species, *S. scorbiculatus* (Münster), and *S. Jaegeri* (calcareous) (Goldfuss), from the Jurassic Limestone. Baireuth.

Caryocrinites (Say).—Pelvis of four plates. Costal plates six. Column not dilated. Alimentary canal round. Articulating surface of the columnar joints radiated. Auxiliary side-arms cylindrical and placed irregularly.

C. ornatus. Costals, four pentagonal and two hexagonal. Column inserted into a cavity at the base of the pelvis. Pelvis rather large; two of the plates quadrangular, attenuated to the base, where they are truncated and a little recurved at the junction with the column; discs, particularly towards the base, granulated, with a distinct elevated interrupted line; two remaining plates pentangular, attenuated to the base where they are truncated and a little recurved at the junction with the column; disc with elevated granules, and with two elevated interrupted lines extending to the terminal angles. Costals, four pentagonal and two hexagonal, all with elevated interrupted lines, radiating from the centre to the angles, with a series of truncated granules on each side and a few granules in the intervening spaces; interscapulars, two hexagonal, situated immediately above the hexagonal costals; scapulars six pentagonal, the upper sides of which are more or less irregular by projecting a little between the scapulæ, all with prominent lines granulated, similar to those of the preceding. Arms six. Capital plates with a heptagonal one in the middle, surrounded by five heptagonal plates and two irregular ones at the mouth. Mouth not prominent, situated on one side of the middle, a little within the line of the arms, closed by small valvular pieces, its inferior side resting on the superior angle of one of the scapulars. Longitudinal diameter from three-quarters to one inch and a half; transverse diameter from seven-tenths to one inch and two-fifths. Mr. Say, who gives this description, records and describes another species with one of the costals hexagonal, namely *C. loricatus*. It was found by Dr. Bigsby loose in brown clay at the foot of the ravine at Lockport, in which the New York Canal mounts the parallel ridge of Lake Ontario.

Marsupites, Mantell (*Marsupiocrinites*, De Blainville).—Body regular, oval, bursiform, rounded at the dorsal extremity, truncated and flattened at the other, enveloped in a sort of shell or test composed of great polygonal plates, articulated to each other, one centrodorsal, and three rows superposed, of which the terminal one supports ten simple rays. Mouth in the midst of four squamiform pieces. Stem none. This is De Blainville's character. The following is Miller's:—"An unattached animal with a subglobose body containing the viscera protected by calcareous plates, of which that in the centre at the base is angular, having a series of costal plates resting on it, admitting intercostals at their superior angles, these giving insertion to the scapulæ from which the arms proceed. Space between the scapulæ covered by an integument, protected by numerous small plates.

M. ornatus, Ornamented Purse-like Animal (Miller), Tortoise Encrinite (Parkinson). A purse-like animal, having the central plate at the base of its subglobose body containing the viscera; pentagonal, supporting at its edge five similar costals, which admit at their superior angles five hexagonal intercostals, into the angles of which five scapulæ are inserted sending off the arms. All the plates ornamented by ridges proceeding from the centre, and forming angular markings near the corners. It is found at Offham Chalk-Pits near Lewes; Clayton Chalk-Pits, Hurstperpoint, Sussex; Preston Chalk-Pits, near Brighton (Mantell); Chalk-Pits of Kent, and Chalk-Pits, near Warminster. (Miller.)

Mr. Miller does not admit *Marsupites* among the *Crinoidea*, but considers it as the immediate link between that family and *Euryale*.

Pentremites (Say).—Column cylindrical, perforated; segments articulating by radiated surfaces, with cylindrical side-arms at irregular intervals; pelvis of three unequal pieces, two pentagonal and one tetragonal; scapulæ large, very profoundly emarginate for the reception of the lips of the radiating ambulacra, obliquely truncated at the extremities on each side for the reception of one side of a subrhomboidal plate or interscapular; ambulacra five, radiating from the summit, and terminating at the tips of the emarginations of the scapulæ: each with a longitudinal indented line, and numerous transverse striæ which terminate in a marginal series of pores, for the transmission of respiratory tubes; summit with five rounded openings (ovaries) and an angulated central one (mouth and anus). (Say.)

"This singular genus," observes M. Say, "is so remotely allied to any hitherto discovered, that I do not think it can, with propriety, be referred to any family yet instituted. By its columnar support it is related to the family *Crinoidea*; but the total absence of arms and hands excludes it from that very natural group. The superior termination, in which the ambulacra, the rounded openings, and the central angulated one, are situated, has some affinity to the family *Echinidea* [ECHINIDÆ], but the columnar support shows that it cannot be arranged there. Having thus on its inferior portion a resemblance to the *Crinoidea*, and on its superior surface a decided analogy to the *Echinidea*, I think it may with propriety form an intermediate family under the following name and characters: Family, *Blastoidea*. Column composed of numerous articulating segments, supporting at its summit a number of plates, so united as to form a calyciform body containing the viscera; arms none; branchiæ arranged in ambulacra. In a natural series their bodies constitute the link between the *Crinoidea* and the *Echinidea*, on the one hand; whilst, on the other, the former is unquestionably, but not more obviously, connected with the *Stelleridea* by the unequivocal intervention of *Comatula* and *Marsupites*. Of all the genera of *Crinoidea*, it is to *Platycrinites* that Pentremite seems most closely related."

M. Say describes three species, namely *P. globosa*, brought from England, and said to have been found in the vicinity of Bath; and *P. pyriformis* and *P. florealis*, from Kentucky. He gives, as the synonyms of the latter, Kentucky Asterial Fossil (Parkinson), and *Encrinites florealis* (Schlotheim), as quoted by Miller, and thus proceeds: "This is extremely abundant in many parts of Kentucky, and on the margins of the Mississippi in a few places. Near Huntsville they are very numerous; and on the surface of a fragment of rock, three inches long by two and a quarter inches wide, sent to the Academy by Mr. Hazard of that place, I have enumerated eighteen specimens of this species more or less entire, and two specimens of the preceding (*P. pyriformis*). On another still smaller piece of rock are twenty-one specimens, all in alto relievo, two of which are of the preceding species. On a third fragment of. rock thirty may be counted, and on a fourth upwards of fifty. That these animals were pedunculated and fixed, there cannot be any doubt. We see at the base of the pelvis a small rounded surface, perforated in the centre for the passage of the alimentary canal, and on the outer margin are very short but distinct radii of elevated lines, evidently intended for articulation with the first joint of the column. The column itself is always found in fragments accompanying the body of the animal, but never attached to it. I think it highly probable that the branchial apparatus commuuicated with the surrounding fluid through the pores of the ambulacra by means of filamentous processes: these may also have performed the office of tentacula in conveying the food to the mouth, which was perhaps provided with an exsertile proboscis; or may we not rather suppose that the animal fed on the minute beings that abounded in the sea-water, and that it obtained them in the manner of *Ascidia*, by taking them in with the water? The residuum of digestion appears to have been rejected through the mouth."

Mr. G. B. Sowerby observes, that all the specimens received in this country from Kentucky were changed iuto a sort of chalcedony or chert, a circumstance which has perhaps not only prevented British naturalists from forming a correct judgment of their natural affiuities as a family, but appears also to have had the effect of preventing them from recognising the generic resemblance to the species that occur here, which, bearing so much greater a similarity to some of the *Echinidæ*, has caused some of our naturalists to class them together: for it is observable, he remarks, that of perhaps twenty specimens of the Kentucky Asterial Fossil that he had examined only one individual showed the sutures that separate what Say calls the "pelvic scapular and interscapular plates or pieces." The examination of the new species however suggested to Mr. Sowerby the probability that part of the three unequal pieces which Say calls the pelvis, may in fact prove to be costals, thus evideucing one more relation to the *Crinoidea*. Mr. Sowerby records and describes two species, premising that the circumstance of Say's first species, *P. globosa*, having beeu brought from England, led Mr. Sowerby at first to suppose that Say might refer to one of those species that had come into Mr. Sowerby's hands. Say's description, however, in Mr. Sowerby's opinion is so incomplete, and the terms he has used are so vague, that Mr. Sowerby had not been able to ascertain the fact, but thinks, nevertheless, that 'Pelvis deep, saucer-shaped, convex,' may serve to distinguish it from both. Mr. Sowerby's two species are *Pentremites Derbiensis* from Derbyshire (limestone) and *P. elliptica* from near Preston in Lancashire.

In a paper ('Zool. Journ.,' vol. iv.) Mr. Sowerby changes the name to *Pentatrematites*, and records three more species, namely *P. angulata*, *P. inflata*, and *P. oblonga;* all from the calamine mines belonging to the Duke of Buccleuch, on the Lancashire side of the Hodder; and in the last volume of the 'Zoological Journal,' he describes three in addition, namely *P. orbicularis*, *P. acuta*, and *P. pentangularis;* the last he considers to be the *Platycrinites pentangularis* of Miller, the arms being imaginary in his figure. Goldfuss describes a species from the transition limestone near Dusseldorf.

De Blainville places this genus at the end of the Crinoideans. It appears to be the connecting link between the *Crinoidea* and the *Echinidæ*, but to have a much stronger relationship to the former than to the latter. *Marsupites* may be regarded as a connection between the true Crinoideans and the *Comatulæ*.

The following is a summary of the distribution of this group of animals, by Professor E. Forbes:—

"This important tribe had its greatest development during the palæozoic and secondary epochs, diminishing materially towards the close of the latter, and becoming scant and scarce during the tertiary and historical epochs. They commence their existence with the earliest sedimentary deposits, and arrive at their maximum of development before the close of the palæozoic periods. In the Lower Silurian they are fragmentary, but common; in the upper beds of that formation many fine species occur ofteu well-preserved in limestone. *Actinocrinus*, *Cyathocrinus*, *Dimerocrinus*, *Rhodocrinus*, *Eugenocrinus*, *Taxocrinus*, *Trochocrinus*, and *Hypanthocrinus* are British Silurian genera. During the Devonian epoch we find the genera *Cyathocrinus* and *Platycrinus*, *Taxocrinus*, and *Adelocrinus*. The limestones of the carboniferous period abound in *Crinoideæ*. Numerous species of *Actinocrinus*, *Platycrinus*, *Cyathocrinus*, *Poteriocrinus* occur, with others of the genera *Rhodocrinus*, *Symbathocrinus*, *Gilbertsocrinus*, *Taxocrinus*, &c. The commencement of the secondary period is marked by abundance of *Pentacrini*, indicative of a new series of crinoidal forms. At Lyme Regis, where they have been found in great uumbers, they occur associated with fossil wood in such a manner, that there can be little doubt that they lived attached to floating masses of wood, probably in shallows. Higher up among the oolitic strata, we find the curious *Apiocrinus* (the Pear-Encrinite) which appears to have lived attached to ancient banks of coral. During the cretaceous epoch the free Crinoids begin to appear, and *Comatulæ* seem to have been not uncommon. Tho genus *Marsupites* is a remarkable form of this group, and disappears before the commencement of the tertiaries. The last of the fossil *Pentacrinites* appear in eocene strata, but as the genus still lives it is probable that intermediate species will he found. *Comatulæ* existed during all the tertiary epochs. In Britain however no trace of it has been found in pleistocene strata. The supposed genera of *Echinidæ*, *Ganymeda* of Gray, and *Glenotremites* of Goldfuss, are only the cups of *Comatulæ*.

"It may be noted generally respecting Fossil Crinoids—1st., That all the genera of the family *Actinocrinidæ* (including such as have cups composed of thin and slightly articulated pieces and having much divided arms), as *Rhodocrinus*, *Actinocrinus*, *Gilbertsocrinus*, *Melocrinus*, *Scyphocrinus*, *Cyathocrinus*, *Platycrinus*, *Dimerocrinus*, *Hypanthocrinus*, &c., are confined to palæozoic strata. 2nd. That all the genera of the family *Poteriocrinidæ* (composed of such as have their cups made up of large and strong segments, but in general aspect closely resembling the members of the first tribe), as *Poteriocrinus*, *Isocrinus*, and *Symbathocrinus*, are palæozoic. 3rd. That the genera of the family *Pentacrinidæ* (characterised by the strongly articulated segments of their cups and head of the column, and by the side-arms of the latter) range from the triassic epoch to our own times, having their maximum during the oolitic epoch. 4th. That the genera of the family *Apiocrinidæ* (characterised by the pear-shaped and articulated summits of the stem and cup, and the naked column), as *Apiocrinus*, *Guettardocrinus*, *Millericrinus*, *Encrinus*, and *Eugenocrinus*, are secondary, and for the most part oolitic. *Encrinus* is a genus not found in British strata, and characteristic of the trias (Muschel-Kalk). It is the well-known Stonc-Lily or Lily-Encrinite of collectious. The genus *Bonigeraticrinus* of D'Orbigny, of which two species are however from the chalk, is an exception to the above rule, if the remains of a Crinoid, found preserved in the recent blauk of the Autilles, be rightly referred to it. 5th. The Free Crinoids, *Comatulidæ*, appear to have ranged from tho oolitic period to the present time; for in the lithographic slates of Bavaria we find several remains of animals closely allied to *Comatulæ*. This family appears to have attained its greatest development during our own epoch, and as certain living species are known to pass through stages exactly comparable to the adult state of the Stalked Crinoid, we must regard the *Comatulidæ* as the most advanced of crinoidal forms."

(Johnston, *Physical Atlas.*)

ENDECA'NDRIA, the ninth class of the Linnæan system of Botauy, distinguished by having nine stamens separate from each other.

ENDIVE. [CICHORIUM.]

ENDOCARP. [FRUIT.]

ENDOGENITES, the name for certain Fossil Plant-Stems, as *E. erosa*, from the Tilgate Beds. (Mantell.)

E'NDOGENS. One of the large primary classes into which the Vegetable Kingdom is divided bears this name, in cousequence of its new woody matter being constantly developed in the first instance towards the interior of the trunk, only curving outwards iu its subsequent course dowuwards. That palm-trees grow iu this way was known so long siuce as tbe time of Theophrastus, who distinctly speaks of the differeuces between endogenous and exogenous wood.

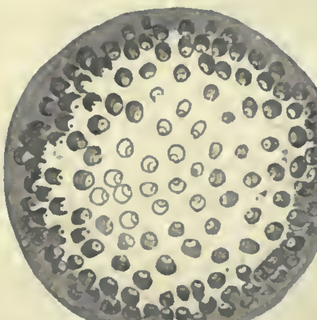
But that this peculiarity is also extended to a considerable part of the vegetable kingdom is a modern fact, the discovery of which we owe to the French naturalists Daubenton and Desfontaines. The path being thus opened, the inquiry has subsequeutly, aud more particularly of late years, been much extended, especially by Professor Mohl, in an elaborate essay upon the anatomy of palms.

Mohl is of opinion that the first year's wood of au Exogen is analogous in arrangement to that of an Endogen, the woody bundles of each leaf curving upwards and outwards to the base of the leaf, and dowuwards and outwards towards the bark, crossing through those which have been previously developed.

The phenomena of growth in a palm-tree may be takeu as typical of the endogenous structure. In the beginning the embryo of a palm consists of a cellular basis, in which a certain number of cords of ligneous fibre are arranged circularly (*fig.* 1), down the radicle, deriving their origin from the plumule. Immediately subsequent to germination, and as soon as the rudimentary leaves of the plumule begin to lengthen, spiral and dotted vessels appear in their tissue in connection with the ligneous cords; the latter increase in quantity as the plant advances in growth, shooting downwards through the cellular tissue, and keeping parallel with the outside of the root. At the same time the cellular tissue increases in diameter to make room for the descending ligneous cords (or woody bundles, as they are also called). At last a young leaf is developed with a considerable number of such cords proceeding from its base downwards, and, as its base passes all round the plumule, consequently passing downwards alike on all sides of the centre that it surrounds. Within this a second leaf gradually unfolds, the cellular tissuo increasing horizontally at the same time; the ligneous cords, however, soon cease to maintain anything like a parallel direction, but curve outwards as they pass downwards, losing their extremities in the roots, or in the cellular integument on the outside of the first circle of cords (*fig.* 1); at the same time the second leaf pushes the first leaf a little from the centre towards the circumference of the plane or cone of growth; the consequence of which is that the ligneous cords next the base of the first leaf are drawn a little outwards, and form descending axes which henceforwards are found at first to curve inwards towards the centre of the young stem, and afterwards outwards towards its circumference. In this manner leaf after leaf is developed, the horizontal cellular system enlarging all the time, and every successive leaf, as it forms at the growing point, emitting more woody bundles curving downwards and outwards, and consequently intersecting the older arcs at some place or other; the result of this is that the first formed leaf will have the upper end of the arcs which belong to it longest, and much stretched outwardly, while the youngest will have the arcs the straightest; and the appearance produced in the stem will be that of a confused entanglement of woody bundles in the midst of a quantity of cellular tissue. As the stem extends its cellular tissue longitudinally while this is going on, the woody arcs are consequently in proportion long, and in fact usually appear to the eye as if almost parallel, excepting here and there, where two arcs abruptly intersect each other. As in all cases the greater number of arcs curve outwards as they descend, and eventually break up their ends into a multitude of fine divisions next the circumference, where they form a cortical integument, it will follow that the greater part of the woody matter of the stem will be collected near the circumference, while the centre is kept comparatively open, and will consist chiefly of cellular tissue; and when, as in many palms, the stem has a limited circumference, beyond which it is its specific nature not to distend, the density of the circumference must, it is obvious, be proportionably augmented. It is, however, a mistake to suppose that the great hardness of the circumference of old palm-wood is owing merely to the presence of augmenting matter upon a fixed circumference; this will account but little for the phenomena. We find that the woody bundles next the circumference are larger and harder than they originally were, and consequently we must suppose that they have the power of increasing their own diameter subsequent to their first formation, and that they also act as reservoirs of secretions of a hard and solid nature, after the manner of the heartwood of Exogens.

When the growth of the stem of an Endogen goes on in this regular manner, with no power of extending horizontally beyond a specifically limited diameter, a stem is formed, the transverse section of which presents the appearance shown in the following cut.

Fig. 1.



There are a number of curved spots crowded together in a confused way, most thick and numerous at the circumference, comparatively small and thinly placed at the centre; and the only regular structure that is observable with the naked eye is that the curves always present their convexity to the circumference.

When there is no limited circumference assigned by nature to an Endogen, then the curved spots, which are sections of the woody arcs, are much more equally arranged, and are less crowded at the circumference. Never is there any distinct column of pith, or medullary rays, or concentric arrangement of the woody arcs; nor does the cortical integument of the surface of endogenous stems assume the character of bark, separating from the wood below it; on the contrary, as the cortical integument consists very much of the finely divided extremities of the woody arcs, they necessarily hold it fast to the wood of which they are themselves prolongations, and the cortical integument can only be stripped off by tearing it away from the whole surface of the wood, from which it does not separate without leaving myriads of little broken threads behind.

This account of the structure of the Endogenous Stem is identical with that given by Dr. Lindley in his 'Vegetable Kingdom.' Schleiden's view of the structure of the stem, as given by Dr. Lindley, is somewhat different. The following passage expounds this view:—

"In all plants, the woody bundles, whose development always proceeds from the interior to the exterior, are either limited or unlimited in their growth. Commonly every woody bundle consists of three different physiological parts; firstly, of a tissue of extreme delicacy, capable of rapid development, in which new cells are continually generated, and deposited in various ways, in two different directions, namely, next the circumference in the shape of a peculiar kind of lengthened cellular tissue with very thick walls, the liber, and next the centre in the form of annular, spiral, reticulate, and porous vessels; secondly of woody cells, which are either uniform in appearance or different, and form wood, properly so called. Up to a certain period the development of the vascular system in Monocotyledons and Dicotyledons proceeds on the same plan; but in Monocotyledons (Endogens) the active, thin, solid, delicate, cellular tissue suddenly changes; the partitions of its cells become thicker, their generating power ceases, and when all the surrounding cells are fully developed, they assume a peculiar form, ceasing to convey gum, mucilage, and other kinds of thick formative sap." From this cause all further development of vascular bundles is rendered impossible, and therefore Schleiden calls the woody bundles of such plants 'limited.' In Dicotyledons (Exogens), on the contrary, this tissue retains during the whole lifetime of the plant its vital power of formation, continues to develop new cells, and so increases the mass, ceaselessly augmenting both the exterior (liber) and the interior faces (wood), for which reason Schleiden calls such woody bundles 'unlimited.' "This," he continues, "happens according to the climate and nature of the plant either pretty continuously, as in *Cactaceæ*, or by abrupt periodical advances and cessations, as occurs in forest-trees of Europe. In the latter, the stem forms an uninterrupted tissue from the pith to the bark during every period of life, and the bark is never organically separated from the stem; what is considered their natural separation in the spring is only a rent, produced by tearing the delicate tissue already spoken of, which is present even during winter, and constitutes the foundation of new annual zones, although compressed, and filled with gum, starch, and other secretions. In the spring, being expanded and swollen by the new amount of sap, it is deprived of its contents by their solution." (Lindley, 'Vegetable Kingdom.')

Schleiden's account of the structure of the Eudogenous or Monocotyledonous stem, as given in his 'Principles of Scientific Botany,' is as follows:—

"The most simple plants of this division have no vascular bundles, as for instance *Wolffia*. Those nearest allied amongst the *Lemnaceæ* first exhibit definite indications of these; in *Spirodela* we even find them combined with spiral vessels, but distributed in a plane surface as the necessary accompaniment of a flat stalk. Many of the *Naiadeæ*, as for instance *Naias*, *Zanichellia*, *Ruppia*, have only a central vascular bundle. In the remainder we meet with the following modifications:—

"1. Developed Internodes.—The stalks and stems have always several rings of vascular bundles, which occasionally inclose a pith, where a circle of vascular bundles are connected by a ring of thickened parenchyma. This is often the most external (usually), often a more internal one, as in *Pothos*. A portion of the vascular bundle passes through the nodes into the leaf, whilst a part rises into the next internode. Small twigs branch off from all the vascular bundles that pass through the nodes, forming a confused plexus in the node, which, for the most part, merges into the axillary bud. The innermost vascular bundles in the nodes supply the lowest leaves, the external bundles the upper ones, as in Grasses, the Cane-stemmed Palms, and the *Commelinaceæ*. There are many groups that have not yet been examined. The whole of the vascular bundles in the same internode are simultaneously formed and developed, and the internode itself, when perennial, does not continue to increase in thickness, whether the plant becomes branched or not. The primary axes, like the secondary, only grow upwards; in fact they are devoid of a cambium-layer.

"2. Undeveloped Internodes.—The stalks (in *Pistia obovata* for instance), and the stems of Palms, herbaceous *Liliaceæ*, bulbs of *Allium*, *Lilium*, &c., have a conical terminal bud, sometimes shorter, in accordance with which the vascular bundles run from below and the exterior, upwards and towards the interior, and then from thence upwards and externally, to pass into a leaf. The arc, which is convex towards the interior, is longer or shorter according to the terminal bud; and the vascular bundle likewise passes through a longer or shorter portion of the whole axis, according to the same conditions. In the full-grown stems of the Palms, the vascular bundles connected with the upper leaves do not reach the base of the stem, notwithstanding the length of the arc. In the simplest case the vascular bundles are wholly isolated; they are however more frequently connected by intermediate branches, seldom from within externally, but often laterally with one another. From this cause, as well as from a more or less extended vertical course of the vascular bundles before they form the arc, the external part of the stem is composed of a thicker cylinder of vascular bundles, whilst the inner portion, composed only of arcs, becoming more and more isolated towards the centre, and cellular tissue increasing in quantity in the inverse proportion, appears much looser.

"However simple we may consider the course of the vascular bundles, in the Monocotyledons, in judging of them according to H. Mohl's researches, it is in fact but seldom so; nevertheless H. Mohl's representation affords the simplest and clearest delineation, and gives the type from which all the analagous structures must be deduced. The separate vascular bundles, especially so far as they form the arc, by no means always run in one and the same vertical plane, their emergence deviating frequently about 50° and more of the circumference of the stem, laterally from the vertical of their starting point, as may be easily observed for instance in *Yucca gloriosa*. The *Xanthorhœa Australis* appears to me to differ most strikingly from the simple type of the stem. Here the fascicles of the vascular bundles emerging into the leaves, evidently have a threefold origin from three different zones of the stem. Quite in the interior another plexus of vascular bundles appears, the course of which however I conld not make out, as the piece in my possession was not sufficiently large for me to have it. Still it appeared to me that the vascular bundles had not quite reached the middle of the stem. It will at least suffice to draw the attention of more favoured observers to this striking structure. Perhaps the history of the development of *Aletris fragrans* will afford some conclusions on the point. An old stem of about 4·25 Paris inches in diameter consists of two parts; the primary stem about 7 lines in diameter, in which the vascular bundles exhibit the usual arc-like course and an external much more solid zone, gradually formed by the cambium-layer. The vascular bundles passing from within to the leaf-cicatrices permeate this external layer in a perfectly horizontal direction. The external layer becomes however divided again into four zones, which produce the appearance of annual rings when seen in the transverse section. The three external ones are when taken together of about the same thickness as the fourth internal one; they differ in this, that in the external ones the fibres do not ascend vertically but obliquely, consequently in a spiral round the axis, and wind towards the left; in the second, in like manner, but winding towards the right; in the third again, turned towards the left; and finally becoming gradually horizontal in the fourth. I may remark here that whilst the parenchyma is arranged in vertical rows in the primary stem, it appears to be in horizontal rows between the external vascular, in the manner of the medullary rays.

"An essential difference presents itself here, according as the formative layer is limited to the terminal bud, or whether there is a continuous layer in the whole circumference of the stem below the rind, which is there bounded internally by it. The latter occurs in the case of normally branching stems, as for instance in the *Dracænæ*, *Aloineæ*, and *Aroideæ*, the former in normally simple stems, as for instance in the *Tulipaceæ* and Palms, with undeveloped internodes. Beautiful investigations on this subject may be found accompanied by the carefully selected results of earlier observations in Unger, (see his 'Bau und Wachsthum des Dikotyledonenstammes,' Petersburg, 1840, page 34). I must finally make mention of the singular stem-formation in the tropical *Orchidaceæ*. A large portion of these, such for instance as are commonly described as having tubers, have not very thick stems (generally branched) with abbreviated internodes. Those branches however which come to blossom produce a peculiar form, which has hitherto been known as tuber (knolle). Either one of the more central internodes of the blossom-bearing branch swells into a disproportionate mass of very varying shape, or all the lower internodes of the branch form a longer or shorter, more or less thick fleshy mass. In both, as for instance in *Epidendrum cochleatum*, and *Bletia Tankervilliæ*, the regular course of the vascular bundles may be distinctly observed, but in the case of the last-named plant (I know not whether the same holds good for all similarly formed) there is a peculiar vascular system intended for the new lateral buds. Little branches pass from the external vascular bundles, and rnn together in a horizontal direction below the rind from both sides up to the buds. On cutting vertically through one of these stems we find a transversely-severed strikingly-large group of vascular bundles below the rind, corresponding to each internode. It unfortunately happens with the *Orchidaceæ* as with the *Cacti* that it is a matter of difficulty to obtain a sufficient quantity of material to ascertain its anatomy or its history of development."

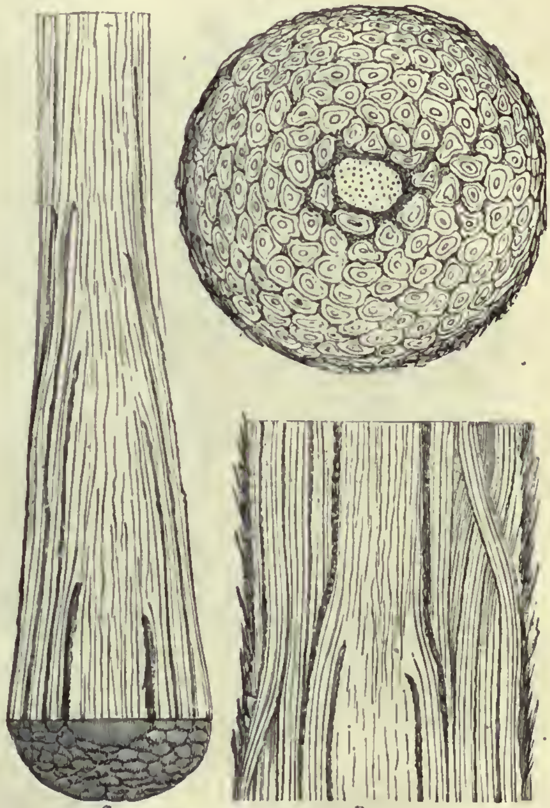
Grasses are Endogens with hollow stems strengthened by transverse plates at the nodes. This is seen in the bamboo, whose joints are used as cases to hold rolls, or in any of our indigenous species. In this case the deviation from habitual structure is owing to the circumference growing faster than the centre, the consequence of which is the tearing the latter into a fistular passage, except at the nodes, where the arcs of ligneous tissue originating in the leaves cross over from one side of the stem to the other, and by their entanglement and extensibility prevent the possibility of any rupture taking place. That this is so is proved by the fact that the stems of all Grasses are solid, or nearly so, as long as they grow slowly; and that it is when the rapidity of their development is much accelerated that they assume their habitual fistular character. Independently of that circumstance their organisation is quite normal.

Xanthorhœa hastilis has been shown by De Candolle to have an anomalous aspect. When cut through transversely the section exhibits an appearance of medullary rays proceeding with considerable regularity from near the centre to the very circumference. ('Organographie Végétale,' t. 7.) But such horizontal rays are not constructed of muriform cellular tissue like real medullary processes, but are composed of ligneous cords lying across the other woody tissue: they are in fact the upper ends of the woody arcs pulled from a vertical into a horizontal direction by the growth of the stem and the thrusting of the leaves to which they belong from the centre to the circumference. Such a case throws great light upon the real nature of the more regular forms of endogenous wood.

Other appearances are owing to imperfect development, as in some of the aquatic species of this class. *Lemna*, for example, has its stem and leaves fused together into a small lenticular cavernous body; and in *Zannichellia* and others a few tubes of lengthened cellular tissue constitute almost all the axis; but the examination of such cases is comparatively unimportant, and would lead too much into details of subordinate interest.

By far the most striking kind of anomaly in the stem of Endogens is that which occurs in *Barbacenia*. In an uupublished species of *Barbacenia* from Rio Janeiro, allied to *B. purpurea*, the stems appear externally like those of any other rough-barked plant, only that their surface is unusually fibrous and ragged when old, and closely coated by the remains of sheathing leaves when young. Upon examining a transverse section of it the stem is found to consist of a small firm pale central circle, having the ordinary endogenous organisation, and of a large number of smaller and very irregular oval spaces, pressed closely together but having no organic connection; between these are traces of a chaffy ragged kind of tissue which seems as if principally absorbed and destroyed (*fig.* 2, A).

Fig. 2. A



C B

A vertical section of the thickest part of this stem exhibits, in addition to a pale central endogenous column, woody bundles crossing each other or lying parallel, after the manner of the ordinary ligneous tissue of a palm stem (*fig.* 2, B), only the bundles do not adhere to each other, and are not embodied as usual in a cellular substance. These bundles may be readily traced to the central column, particularly in the younger branches (*fig.* 2, C), and are plainly the roots of the stem, of exactly the same nature as those aërial roots which serve to stay the stem of a Screw-Pine (*Pandanus*). When they reach the earth the woody bundles become more apparently roots, dividiug at their points into fine segments, and entirely resembling on a small scale the roots of the palm-tree. The central column is much smaller at the base of the stem than near the upper extremity.

The age of endogenous trees has been little studied. When the circumference of their stem is limited specifically it is obvious that their lives will be limited also; and hence we find the longevity of palms inconsiderable when compared with that of exogenous trees. Two or three hundred years are estimated to form the extreme extent of life in a Date-Palm and in many others. But where, as in *Dracæna*, the degree to which the stem will grow in diameter is indefinite the age seems, as in Exogens, to be indefinite also; thus a famous Dragon-Tree, *Dracæna Draco*, of Oratava, in Teneriffe, was an object of great antiquity so long ago as A.D. 1402, and is still alive.

Important as the character furnished by the internal manner of growth of an Endogen obviously is, it is much enhanced in value by its being found very generally accompanied by peculiarities of organisation in other parts. The leaves have in almost all cases the veins placed in parallel lines, merely connected by transverse single or nearly single bars. Straight-veined foliage is therefore an external symptom of an endogenous mode of growth. When such an appearance is found in Exogens it is always fallacious, and is found to be owing to the excessive size and peculiar direction of a few of the larger veins, and not to be a general character of all the venous system; as is sufficiently obvious in *Plantago lanceolata*, *Gentiana lutea*, and many more.

The flowers too of Endogens have in most cases their sepals, petals, and stamens corresponding with the number three, or clearly referrible to that type; and the pistil usually participates in the same peculiarity. Where such a proportion exists in Exogens it is usually confined to the sepals and petals by themselves, or to the pistil by itself, not extending to the other organs. In Endogens it is almost universal in all the whorls of the flower, although sometimes obscured by the abortion, dislocation, or cohesion of particular parts, as happens in the whole of the extensive natural order of grasses.

and a plumule from a little above the radicle; in other cases its embryo has a slit on one side, in the cavity of which the plumule reposes, or, finally, the embryo is a flat plate as in Grasses, with the plumule and radicle attached to its face near the base. In the latter case the flat plate is a solitary cotyledon, which in the second instance is folded together so as to give the embryo the appearance of being slit, and, which in the first or most habitual condition is not only folded up but united at its edges into a case, entirely burying the plumule and cotyledon. Hence the embryo of an Endogen is called Monocotyledonous; a name that is really unexceptionable, notwithstanding the occasional appearance of a second rudimentary cotyledon, as occurs in common wheat.

It has already been stated that the radicle is protruded in germination from within the substance of the embryo; the base of the radicle is consequently surrounded by a minute collar formed of the edges of the aperture produced by the radicle upon its egress. For this reason Exogens are called endorhizal.

Hence the great natural class of plants forming the subject of these remarks has five most important physiological peculiarities, by all which combined, or usually by each of which separately, the class may be characterised :—

Endogenous Vegetation.

Palmaceæ, consisting of *Cocos capitata* (*a*); *Manicaria saccifera* (*b*); *Iriartea ventricosa* (*f*). *Pandanaceæ*, represented by *Pandanus odoratissimus* (*c*); *Musaceæ*, by *Musa Sapientum* (*d*); *Graminaceæ*, by *Bambusa arundinacea* (*e*); and Arborescent *Amaryllidaceæ*, by *Agave Americana* (*g*). The fore and back grounds are composed of small palms, grasses, rushes, and liliaceous plants.

The effect of the manner of growth in Endogens is to give them a very peculiar appearance. Their trunks frequently resemble columns rising majestically with a plume of leaves upon their summit; and the leaves, often very large—the fan-shaped leaves of some palms are from 20 to 30 feet wide—have most commonly a lengthened form, resembling a sword-blade if stiff, or a strap if weak and broad. A landscape consisting entirely of Endogens would have such an appearance as is presented by the cut in this page.

These peculiarities are connected with others belonging to endogenous vegetation in its most rudimentary condition. The embryo of an Endogen is in its commonest state a small undivided cylinder, which protrudes from within its substance a radicle from one end

1. The wood is endogenous.
2. The leaves are straight-veined.
3. The organs of fructification are ternary.
4. The embryo is monocotyledonous.
5. The germination is endorhizal.

This explains why Endogens are also called Monocotyledons and *Endorhizæ*; they have moreover been called *Cryptocotyledoneæ* by Agardh, *Acroblastæ* by Reichenbach, and *Caulophytæ* by the school of Oken.

It may however be readily supposed that, viewed as a large class of plants, Endogens are essentially characterised only by the combination of these five peculiarities, and that occasional deviations may occur from every one of them. Thus in *Nais*, *Caulinia*, *Zannichellia*, and others which constitute a part of what Professor Schultz names Homorganous Floriferous Plants, the whole organisation of the stem is so imperfect that the endogenous character is lost; but their true nature is nevertheless sufficiently indicated by their straight veins, monocotyledonous embryo, &c. Again, in *Smilax*, the common reticulated leaves of Exogens are found; but the endogenous stem, the ternary organs of fructification, the embryo and germination of that order, are all good evidences of its real nature; and so with other cases. Such occurrences are instances of endogenous developmeut tending towards the exogenous, and are usually looked upon as cases of transition from one form to the other—perhaps not very correctly. Of this nature are the resemblances between the columnar Cycadaceous Gymnosperme and Palms, between the livid, fœtid, one-sided calyx of *Aristolochia*, and the equally livid, fœtid, one-sided spathe of Araceous Endogens, or, in another point of view, between such lenticular plants as *Lemna* in Endogens, with the leaves and stems fused as it were together, and similar forms of stem and leaf among Marchantiaceous Acrogens.

With regard to really intermediate forms of vegetation connecting Endogens with other classes, they are extremely uncommon. One of the most striking is that which occurs between *Ranunculaceæ* and *Nymphæaceæ* on the part of Exogens, and *Alismaceæ* and *Hydrocharaceæ* on that of Endogens; if *Ranunculus lingua*, or better *R. parnassifolius*, is contrasted with *Alisma Plantago*, or *Damasonium*, leaving out of consideration subordinate differences, it will be found that there is little of a positive nature to distinguish them except the albuminous dicotyledonous seeds of the former as compared with the exalbuminous monocotyledonous seeds of the latter; and the resemblances between *Hydropeltis* and *Hydrocharis* in the other case, are so very great that Schultz and others actually refer them to the same class.

Endogens probably contain more plants contributing to the food of man, and fewer poisonous species in proportion to their whole number, than Exogens. Grasses, with their flowery albumen, form a large portion of this class, to which are to be added Palms yielding fruit, wine, sugar, sago; *Araceæ*, *Marantaceæ*, some *Amaryllidaceæ*, &c., producing arrow-root, the nutritious fruit of the Plantains, the aromatic secretions of *Zingiberaceæ*, *Orchidaceæ*, forming salep, and *Dioscoreaceæ*, the mothers of Yams. Among the deleterious species we have little worth notice beyond the poisonous mucilage in the bulbs of certain *Amaryllidaceæ*, and the acrid secretions of *Araceæ*.

In these, as in all other large groups, we find the extremes of development so exceedingly far apart, that one would be almost tempted to doubt the possibility of their being mere forms of each other, were it not certain that numerous traces exist in the vegetable kingdom of a frequent tendency to produce the typical structure of a natural association of whatever kind in both an exaggerated and degraded state, if such figurative terms may be employed in science. For instance, the genus *Ficus* contains some species creeping on the ground like diminutive herbaceous plants, and others rising into the air to the height of 150 feet, overspreading with the arms of their colossal trunks a sufficient space of ground to protect a multitude of men. The type of organisation in the willow is in like manner represented on the one hand by the tiny *Salix herbacea*, which can hardly raise its head above the dwarf moss and saxifrages that surround it; and on the other by *Salix alba*, a tree 60 feet high. Then among natural orders we have the Rosaceous structure, exaggerated on the one hand into the arborescent *Pomeæ*, and degraded on the other into the apetalous imperfect *Sanguisorbeæ*; the Onagraceous type, highly developed in *Fuchsia*, and almost obliterated in *Halorageæ*; the Urticaceous, in excess in *Artocarpus*, and most imperfect in *Ceratophyllum*; Grasses, presenting the most striking differences of perfection between the moss-like *Knappia*, and Bamboos 100 feet high; and the Liliaceous occurs in equally different states of development, when Asparagus is compared with the Dragon-Tree, or an autumnal squill with an arborescent *Yucca*. So, in like manner, we find at one extreme of the organisation of the class of Endogens, palms, plantains, and arborescent liliaceous plants, and at the other, such submersed plants as *Potamogeton*, *Zannichellia*, and Duckweed, the latter of which has not even the distinction of leaf and stem, and bears its flowers, reduced to one carpel and two stamens, without either calyx or corolla—therefore at the minimum of reduction, if to remain flowers at all—in little chinks in its edges.

The classification of Endogens is not a subject upon which there is any very great diversity of opinion among botanists; if the natural orders are sometimes not distinctly limited, they are, upon the whole, grouped much better than those of Exogens; and although it may be expected, whenever more positive rules for classification than are yet known shall have been discovered, that great changes will be introduced into this part of systematic botany, yet we do not contemplate the probability of disturbing the limits of the natural orders themselves to any considerable extent.

The system we have followed in this work is that of Dr. Lindley as given in his 'Vegetable Kingdom.' In the arrangement of the Endogens, in the first place, all those species whose flowers are like Grasses are placed together under the Glumal alliance. They may be justly regarded as the lowest point of structure to which Endogens are reduced. Their flowers are made up of scales or bracts, without any attempt at the regularity of arrangement which we find occuring with plants which have a calyx and corolla present. The relatiou of the Bullrushes (*Typhaceæ*) to these is obvious, but their flowers are more regular, and hence they are placed with *Araceæ* in the Aral alliance, and this is followed by the Palms and a small group of water-plants, the *Hydrales*. These all have the stamens and pistils on separate flowers, those which follow have the stamens and pistils together in the same flower. In the following analysis signs are used for this distinction, thus— ♂ indicates flowers bearing pistils alone; ♀ stamens alone; and ⚥ bearing both together. 0 indicates the absence of the organ against which it is placed.

Alliances of Endogens.

I. Glumales.—Flowers glumaceous (that is to say, composed of bracts not collected in true whorls, but consisting of imbricated, colourless, or herbaceous scales).

Graminaceæ.—Ovary 1-celled, with 2 or more distinct (or united) styles. Ovule ascending. Embryo lateral, naked.

Cyperaceæ.—Ovary 1-celled, with 2 or more (distinct or) united styles. Ovule erect. Embryo basal.

Desvauxiaceæ.—Ovary several (sometimes united), with 1 style to each. Ovule pendulous; glumes only. Stamens 1-2. Anthers 1-celled. Embryo terminal.

Restiaceæ.—Ovary 1-2-3-celled, with 2 or 3 styles always. Ovule pendulous; glumes only. Stigmas 2-3. Anthers 1-celled. Embryo terminal.

Eriocaulaceæ.—Ovary 2-3-celled, with 1 style to each cell. Ovule pendulous; a membranous 3-lobed cup within the glumes. Anthers 2-celled. Embryo terminal.

II. Flowers petaloid, or furnished with a true calyx or corolla, or with both, or absolutely naked. ♂ ♀ (that is, having sexes altogether in different flowers.)

Arales.—Flowers naked or consisting of scales, 2 or 3 together, or numerous, and then sessile on a simple naked spadix. Embryo axile. Albumen mealy or fleshy. (Some have no albumeu.)

Pistiaceæ.—Flowers 2 or 3, of which 1 only is ♀. Spadix 0. Ovary 1-celled. Ovules erect. Embryo slit.

Typhaceæ.—Flowers ♂ ♀, on a naked spadix. Calyx scaly or hairy. Anthers with long filaments. . Ovule solitary, pendulous. Seed adherent to the pericarp. Embryo slit.

Araceæ.—Flowers ♂ ♀, naked on a solitary spadix covered by a single hooded spathe. Anthers sessile. Seed loose. Embryo slit, axile.

Pandanaceæ.—Flowers ♂ ♀. Naked or scaly, on a spadix covered by many spathes. Anthers stalked. Seeds loose. Embryo solid, minute.

Palmales.—Flowers perfect (with both calyx and corolla), sessile, on a branched scaly spadix. Embryo vague, solid. Albumen horny or fleshy. (Some Palms are ⚥.)

Palmaceæ.—Characters as in the alliance.

Hydrales.—Flowers perfect or imperfect, usually scattered. Embryo axile, without albumen. Aquatic. Some are ⚥.

Hydrocharidaceæ.—Stamens epigynous. Ovary adherent.

Naiadaceæ.—Stamens hypogynous. Ovary free. Pollen globose.

Zosteraceæ.—Stamens hypogynous. Ovary free. Pollen confervoid.

III. Flowers furnished with a true calyx and corolla, adhereut to the ovary. ⚥.

Narcissales.—Flowers symmetrical. Stamens 3 or 6 or more; all perfect. Seeds with albumen. Flowers unsymmetrical. Some *Bromeliaceæ* have a free calyx and corolla.

Bromeliaceæ.—Flowers tripetaloideous, 6-leaved, imbricated. Albumen mealy.

Taccaceæ.—Flowers half tripetaloideous, tubular. Albumen fleshy.

Hæmodoraceæ.—Flowers hexapetaloideous, tubular, scarcely imbricated. Stamens 3, opposite the petals, or 6 anthers turned inwards. Radicle remote from the hilum, which is naked.

Hypoxidaceæ.—Flowers hexapetaloideous, much imbricated. Stamens 6. Anthers turned inwards. Radicle remote from the hilum, which is often strophiolate.

Amaryllidaceæ.—Flowers hexapetaloideous, much imbricated. Stamens 6 or more. Anthers turned inwards. Radicle next the hilum.

Iridaceæ.—Flowers hexapetaloideous. Stamens 3, opposite the sepals. Anthers turned outwards.

Amomales.—Flowers unsymmetrical. Stamens 1 to 5, some at least of which are petaloid. Seeds with albumen.

Musaceæ.—Stamens more than 1. Anthers 2-celled. No vitellus.

Zingiberaceæ.—Stamen but 1. Anther 2-celled. Embryo in a vitellus.

Marantaceæ.—Stamen but 1. Anther 1-celled (halved). No vitellus.

Orchidales.—Stamens 1 to 3. Seeds without albumen.

Burmanniaceæ.—Flowers regular. Stamens free, perigynous.

Orchidaceæ.—Flowers irregular, gynandrous. Placenta parietal.

Apostasiaceæ.—Flowers regular, half gynandrous. Placenta axile.

IV. Flowers furnished with a true calyx and corolla, free from the ovary. ☿

XYRIDALES.—Flowers half herbaceous, 2-3 petaloideous. Albumen copious.

Philydraceæ.—Sepals 0. Petals 2. Stamens 3, of which 2 are abortive. Embryo axile, in fleshy albumen.

Xyridaceæ.—Sepals 3. Petals 3. Stamens 3, fertile. Carpels opposite sepals. Placenta parietal. Embryo minute, on the outside of fleshy albumen.

Commelynaceæ.—Sepals 3. Petals 3. Stamens 6 (or 3). Carpels opposite sepals. Placentæ axile. Embryo trochlear, half immersed in fleshy albumen.

Mayaceæ.—Sepals 3. Petals 3. Stamens 3 (anthers 1-celled). Carpels opposite petals. Placentæ parietal. Embryo minute on the outside of fleshy albumen.

JUNCALES.—Flowers herbaceous, dry and permanent, scarious if coloured. Albumen copious. (Some Callas have no albumen.)

Juncaceæ.—Flowers scattered. Embryo minute, undivided.

Orontiaceæ.—Flowers spadiceous. Embryo axile, with a conspicuous cleft on one side.

LILIALES.—Flowers hexapetaloideous, succulent, and withering. Albumen copious.

Gilliesiaceæ.—Perianth surrounded by a calycine involucre, the inner bracts of which are coloured and petaloid.

Melanthaceæ.—Perianth naked, flat when withering. Anthers turned outwards; styles distinct. Albumen fleshy.

Liliaceæ.—Perianth naked, flat when withering. Anthers turned inwards; styles consolidated. Albumen fleshy.

Pontederaceæ.—Perianth naked, circinate when withering. Anthers turned inwards. Albumen mealy.

ALISMALES.—Flowers 3-6, petaloideous, apocarpal. Albumen none. (Some *Alismaceæ* are absolutely ♀ ♂.)

Butomaceæ.—Flowers 3, petaloideous. Placentæ many-seeded, netted, and parietal.

Alismaceæ.—Flowers 3, petaloideous. Placentæ few-seeded, simple, and axile, or basal. Embryo solid.

Juncaginaceæ.—Flowers scaly. Placentæ few-seeded, simple, and axile, or basal, slit on one side, with a very large plumule.

The Endogenous Orders probably contain more plants yielding food for man, and less plants yielding poisons in proportion to their numbers, than those belonging to Exogens. The *Graminaceæ* are found all over the world, and are cultivated by most civilised and semi-civilised nations, and yield a large proportion of the substantive food of the human family. Palms are of the utmost importance in countries where they grow, yielding fruits, wine, sugar, sago, and other products. Many of them yield starch from their root-stocks, as the arrow-root plants, Arums, Orchises, and the like. Aromatic secretions are yielded by the Gingers, and deleterious substances by the *Melanthaceæ* and *Araceæ* more particularly.

ENDOPHLEUM. [BARK.]

ENDORHIZÆ. [ENDOGENS.]

ENDOSMOSIS, a name given by Dutrochet to the process by which fluids pass from the exterior to the interior of a cell. This process seems to result from two distinct agencies, which are always brought into operation where fluids pass through a membrane. The one is the imbibition of the fluid by the porous cell-membrane, and the other is the mutual diffusion of miscible fluids. From the researches of Matteucci and others there can be little doubt that the passage of a gas or liquid through an animal or vegetable membrane is but the modification of the process of attraction by which fluids are absorbed by solid bodies. This process is carried on with various degrees of force in different materials, and seems to depend on the degree of attraction subsisting between the particles of the solid and those of the fluid. Matteucci found that when glass tubes of about three-quarters of an inch diameter were filled with fine sand previously dried, and introduced without pressure, and were immersed at their lower ends into the following liquids, the action of imbibition raised the liquids in the tubes to the following height:—

Solution of Carbonate of Potash	85	millimetres.
Solution of Sulphate of Copper	75	"
Serum of Blood	70	"
Solution of Carbonate of Ammonia	62	"
Distilled Water	60	"
Solution of Common Salt	58	"
Milk	55	"
White of Egg, diluted with its own volume of water	35	"

In these cases the imbibition took place at first rapidly, then more slowly, and ceased entirely at the end of ten hours. When thick solutions of gum, or starch, or fixed oils were employed, scarcely any imbibition took place, and it was but little more when strong saline solutions were used. The degree in which different fluids pass into different solids will be seen in the following table:—

	Sand.	Pounded Glass.	Saw-dust.
Alcohol	85 mill.	175 mill.	125 mill.
Water	175 "	182 "	60 "

Thus showing that water passed more freely than alcohol into sand, but less freely into saw-dust, and both fluids passed with equal facility into pounded glass. The size of the tubes employed in these experiments and the temperature affected considerably the results. The fluids rose higher in proportion as the temperature increased. This enables us to understand the influence of heat on life by the physical effects it produces.

Not only is the passage of fluids from the exterior to the interior of a cell facilitated by the attraction between the cell-wall and the fluids, but the fluids on either side of the membrane have a tendency to mix with each other, which cannot but assist in this process. Professor Graham has shown that not only have gases an inherent tendency to mix with each other, independent of the laws of gravity, but that this law also applies to the miscibility of liquids. In a Memoir on this subject in the 'Philosophical Transactions' for 1850, he has shown the laws which this diffusion of liquids obeys. Different substances possess this property in different degrees. Thus, when solutions of the following substances were used, of the strength of 20 parts to 100 parts of water, the relative quantities diffused in a given time were as follows:—

Chloride of Sodium	58·68
Sulphate of Magnesia	27·42
Nitrate of Soda	51·56
Sulphate of Water	69·32
Crystallised Cane-Sugar	26·74
Starch-Sugar (Glucose)	26·94
Gum Arabic	13·24

The experiments from which these results were obtained, were performed by inverting a phial containing the solution to be diffused in a large jar of pure water. The diffusion was stopped after seven or eight days, and the amount of diffusion was determined by evaporating the water of the jar to dryness. There can be little doubt that the relative diffusibility of the juices of plants and animals must have an important influence on the changes which go on in the cells during the performance of the functions of the vegetable or animal body. "Thus," observes Dr. Carpenter, "the low diffusibility of albumen obviously tends to the retention of the serous fluids within the tissues; whilst the high diffusibility of urea will favour its escape from them." The following is an account of the process of Endosmosis, and some of the conclusions at which we may arrive, from Dr. Carpenter's 'Principles of Physiology:'—

"If into a tube, closed at one end with a piece of bladder or other membrane, be put a solution of gum or sugar, and the closed end be immersed in water, a passage of fluid will take place from the exterior to the interior of the tube, through the membranous septum; so that the quantity of the combined solution will be greatly increased, its strength being proportionably diminished. At the same time, there will be a counter-current in the opposite direction; a portion of the gummy or saccharine solution passing through the membrane to mingle with the exterior fluid, but in much less quantity.

"The first current is termed Endosmose, and the counter-current Exosmose. The increase on either side will of course be due to the relative velocity of the currents; and the changes will continue until the densities of the two fluids are so nearly alike as to be incapable of maintaining it. The greater the original difference (provided that the denser be not actually viscid, but be capable of mixing with the other), the more rapidly and powerfully will the process be performed. The best means of experimenting upon the phenomena is afforded by a tube, narrow above, but widely dilated below, so as to afford a large surface to the membrane, compared with that of the superincumbent column, which will then increase in height with great rapidity. By bending this tube in the form of a syphon, and introducing into its curve a quantity of mercury, the force as well as the rapidity of the Endosmose between different fluids may be estimated with precision. In this way it was ascertained by Dutrochet, in some of his experiments, that fluid might be raised against a pressure of no less than 4½ atmospheres, or nearly 70 lbs. to the square inch. Although it is not universally true that the activity of the process depends upon the difference in density of the two fluids (for in one or two cases the stronger current passes from the denser to the lighter), it seems to be so with regard to particular solutions, as those of gummy or saccharine matter. No endosmose takes place between fluids which will not mingle, such as oil and water; and very little between such as act chemically on each other. Although an organic membrane forms the best septum, yet it has been found that thin laminæ of baked pipe-clay will suffice for the evident production of the phenomenon; and that porous limestones possess the same property in an inferior degree. Although it may not yet be possible to explain all the phenomena of Endosmose upon physical principles, yet these will go so far towards it that the general conditions of the process may be considered as well understood. Supposing that two mutually diffusible liquids are on the opposite sides of a porous septum, which is not equally penetrable by them, then the one which is most readily imbibed will tend to occupy the capillary passages of the septum, and will thus be brought into contact with the liquid on the opposite side. This contact will permit the diffusion of that which has passed through the pores of the septum; and as fast as that which occupies these pores is removed by diffusion, so fast will it be renewed on the other side,—just as oil continues to ascend through the capillary channels in the wick of a lamp, so long as it is being dissipated by the combustive process at its summit. In this way then an endosmotic current is produced, the force of which will depend upon the diffusion-powers of the two liquids, and upon the difference of the attractive power which the capillary tubes of the septum have for the two respectively. Thus when a solution of sugar or gum is on one side of the septum, and water on the other, the water is the most readily imbibed; and consequently the chief mixture and diffusion of the liquids, the one through the other, takes place at the surface of the septum in contact with the more viscid liquid. But at the same time this liquid is tending to diffuse itself through the water which occupies the capillary channels of the septum; and as it is not repelled by the septum, but is only attracted by it in a less degree than the water, a portion of it finds its way in a direction opposed to the principal current, and diffuses itself through the water on the other side, thus constituting Exosmose. Thus it happens that the direction of the principal current, or Endosmose, will be determined by the attractive power of the septum for one or the other of the liquids; though the diffusion-power of the liquids through each other will help to determine its force. When alcohol and water, for example, are separated by a septum composed of animal membrane, the endosmotic current will be from the water towards the alcohol, because the former liquid more readily 'wets' the membrane, and consequently tends most strongly to occupy its capillary passages; but, on the other hand, when the separation is made by a thin lamina of caoutchouc, the endosmotic current is from the alcohol towards the water, because the former is most readily imbibed by the septum. It has further been ascertained by the experiments of Matteucci, that when an organic membrane is employed as a septum, the rapidity of transmission is considerably affected by the direction in which the endosmotic current traverses the membrane. Thus, when the skin of the Torpedo was employed, with a solution of sugar on one side of it and water on the other, although there was always an endosmotic current from the water to the sugar, yet this current was strong enough to raise the interior liquid to 80° when the water was in contact with the internal surface of the membrano, in the same time that was occupied by its rise to 20° when the external surface of the membrane was turned towards the water. Again, when the mucous membrane of the stomach of a dog was used as the septum, and its external (or muscular) surface was placed in contact with alcohol, the passage of water from the other side took place with such rapidity as to raise the liquid in the tube to 130°; whilst if the internal (or mucous) surface of the membrane were placed in contact with the alcohol, and the muscular surface with water, the current was only sufficient to raise the liquid 6 degrees in the same time; so that it is evident that the transudation of water takes place much more readily from the mucous lining of the stomach towards the outer side of the viscus than in an opposite direction, in virtue simply of the physical properties of the membrane. In fact, according to Professor Matteucci, the cases are very rare in which, with fresh membranes, Endosmose takes place with equal readiness, whichever of the two sides is exposed to the water.

"The direction which is most favourable to Endosmose through skins is usually from the internal to the external surface, with the exception of the skin of the frog, in which the endosmotic current, in the single case of water and alcohol, takes place most readily from the external to the internal surface. But when stomachs and urinary bladders are employed, the direction varies much more, according to the nature of the liquids employed. This variation appears to have some relation to the physiological conditions in which these membranes are placed in the living animal; thus, the direction most favourable to Endosmose between water and a saccharine solution, is not the same for the stomach of a ruminant as for that of a carnivorous animal: as yet however no positive statement can be made on this subject. When membranes are employed that have been dried or altered by putrefaction, we either do not observe the usual difference arising from the position of the surfaces, or Endosmose no longer takes place; thus affording another indication that it is to the physical condition of the perfectly-organised membrane that we are to look for many of the peculiarities which are noticeable in the transudation of fluids through them. The exosmotic current does not bear any constant relation to the endosmotic, as may be easily comprehended from the preceding explanation; for if the liquids have a strong tendency to mutual diffusion, and the difference in attractive power which the septum has for them respectively is not great, each may find its way towards the other, and a considerable exosmose may ensue, with very little change of level. The amount of the exosmotic as of the endosmotic current, varies with the direction in which it traverses the membrane; thus, when sugar, albumen, or gum was employed in solution, its transudation towards water took place most readily from the internal towards the external surface of all the skins examined by Matteucci, a fact which is not without its significance, when it is remembered that it is in this direction that the secretion of mucus takes place on the skins of fishes, frogs, &c.

"Applying these considerations to the phenomena of imbibition of liquids into the tissues and canals of the living body, we shall have to inquire how far they are capable of being accounted for on physical principles, which have been now brought forward. It has been maintained by some that absorption is a purely vital operation, because it does not occur save during the continuance of life. But this is not true, since imbibition will take place into dead tissues, though more slowly than into some parts when living; and the difference of rate seems to be fully accounted for by the difference of the condition between a mass of tissue, all whose fluids are stagnant, and another in which an active circulation is taking place. Thus, as Matteucci has shown, if the hind legs of a frog recently killed be immersed for some hours in a solution of ferrocyanide of potassium, it will be found that every part of the viscera is so penetrated with the salt, that by touching it with a glass rod moistened with a solution of chloride of iron, a more or less deep blue stain is the result. Now, the same effect is produced much more speedily in a living frog; and it is easily proved that the imbibition takes place in the latter case into the blood-vessels, and that the salt is conveyed to the remoter parts of the body by the circulation, instead of having slowly to make its way by transudation through the tissues, as in the dead animal. But further, not only does the movement of blood in the vessels promote the diffusion of liquid, which has been already observed, it also increases the rapidity of the absorption itself in a very extraordinary degree. Thus, if a membranous tube, such as a piece of small intestine, or of a large vein of an animal, be fixed by one extremity to an opening at the bottom of a vessel filled with water, and have a stop-cock attached at the other extremity, and be then immersed in water ascidulated with sulphuric or hydochloric acid, it will be some time before the acid will penetrate to the interior of the tube, which is distended with water; but if the stop-cock be opened, and the water be allowed to discharge itself, the presence of the acid will be immediately discovered (by tincture of litmus) in the liquid which flows out, showing that the acid has been assisted in its penetration of the walls of the tube by the current traversing its interior. Thus, the continuance of circulation is obviously one of the most patent of all the conditions of absorption, and the difference in the rate of the process in the dead and living organisms, placed under the same circumstances, may be accounted for in great part, if not entirely, by the stoppage of the circulation in the former. All the circumstances which are laid down by physiologists as favouring absorption are in strict accordance with the physical principles which have been now explained. These circumstances are—1. The ready miscibility of the liquids to be absorbed with the juices of the body. 2. The penetrability of the tissue through which the absorption takes place. 3. The absence of previous distention in the tissues or canals towards which the flow takes place. 4. The elevation of the temperature within certain limits. 5. The vascularity of the tissues, and the rate of movement of the blood through the vessels. And the results of experiments upon recently-dead membranes which retain almost exactly the same physical conditions as those which they possessed during life, but have entirely lost their vital properties, seem most decidedly to indicate that the relative facility with which different substances are absorbed, and the direction most favourable to their passage through the tissues, are determined in great part by the physical relations of those tissues (and of the vessels which traverse them) to the liquid which is seeking to enter them. In this way, then, many of the phenomena of selective absorption are probably to be explained, especially in plants and the lower animals. The special absorbent vessels, however, of *Vertebrata* seem to possess properties which can scarcely be thus accounted for." ('Principles of Physiology.') [ABSORPTION; ABSORBENT VESSELS.]

ENDYMION, a genus of Plants belonging to the class of Endogens, the order *Liliaceæ*, and the tribe *Hemerocallideæ*. It has a tubular bell-shaped perianth, composed of six connivent leaves, with reflexed points combined below. The stamens are inserted below the middle of the perianth; the filaments decurrent.

E. nutans, the English Blue-Bell. It is also the *Scilla nutans*, the *Hyacinthus non-scriptus*, and *Agraphis nutans* of various botanical writers. It has linear leaves, with nodding racemes, the flowers bell-shaped, cylindrical; the apex of the sepals revolute; the bracts 2. This is a very common plant, flowering in May in the woods and thickets of England. It is also common in France and Belgium. The flower-stalk is about a foot high. The leaves are shorter than the flower-stalk. The flowers are generally blue. A white variety is however occasionally seen.

ENGRAULIS. [ANCHOVY; CLUPEIDÆ.]

ENGYSTOMA. [AMPHIBIA.]

ENHALUS, a genus of Plants belonging to the natural order *Hydrocharidaceæ*, the fruit of which, according to Agardh, is eatable, and the fibres capable of being woven.

ENHYDRA. [OTTERS.]

ENNEAGONA. [ACALEPHÆ.]

ENTALOPHORA. [SERTULARIADÆ.]

ENTEROMORPHA. [ALGÆ.]

ENTO'BIA, a genus of Fossil *Annelida*. (Portlock.)

ENTOMOCO'NCHUS, a genus of Fossil *Crustacea*, from the Mountain Limestone of Ireland. (M'Coy.)

ENTOMO'LOGY, that branch of science which treats upon insects.

The term Entomology literally signifies a discourse upon insects, it being derived from the two Greek words "Εντομον, an insect, and Λόγος, a discourse.

The term Entoma was first applied to these animals by Aristotle, and is synonymous with the Latin word *insecta* (whence is derived the English name 'insects'), both having reference to a striking character exhibited in the insect tribe, that of having the body insected, or, as it were, cut and divided into numerous segments. [INSECTA.]

ENTOMOSTO'MATA, De Blainville's name for his second family of his first order, *Siphonobranchiata*, of his first sub-class *Paracephalophora Dioica*, of his second class, *Paracephalophora*, of *Malacozoa*. This family appears to be nearly the same with the genus *Buccinum* of Linnæus and family *Buccinidæ* of other naturalists. It is thus characterised by De Blainville :—

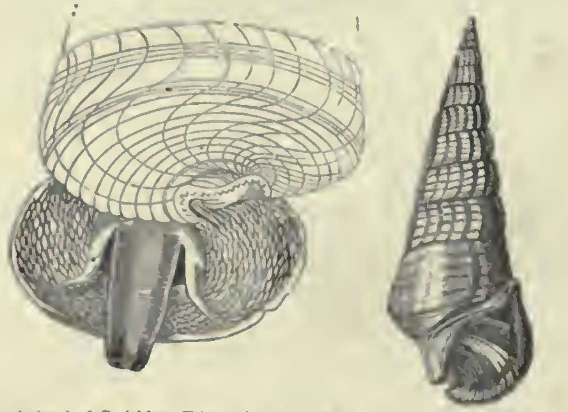
Animal spiral, with the foot, which is shorter than the shell, rounded in front. Mantle provided in front of the respiratory cavity with a long canal always uncovered, which the animal uses as an organ of prehension. Head furnished with a single pair of blackish tentacula, which carry the eyes on an enlargement (renflement) of the half of their base. Month armed with a proboscis, as in the preceding family (*Siphonostomata*), without any labial tooth, but with a small tongue. Organs of respiration formed by two unequal pectinated branchiæ. Organs of generation—termination of the oviduct in the females at the right side, at the entrance of the branchial cavity. Termination of the deferent canal at the extremity of a long flattened contractile excitatory appendage, situated at the right side of the neck. Shell very variable in form, whose opening, sometimes very large and sometimes very small, is without an apparent canal, or with a very short one suddenly recurved upwards, but always more or less deeply notched anteriorly. Operculum horny, unguiform, oval, subconcentric, with the summit a little marked and marginal.

De Blainville observes that this family differs evidently very little from that of the *Siphonostômata*, whether in the soft parts or in the shell. The species which it embraces are not all absolutely marine, though a very great number of them are: some live at the mouths of rivers, and a very small number are entirely fluviatile.

The following are the principal genera of this family :—

* Turriculated.

Cerithium.—Animal very much elongated, the mantle prolonged into a canal at its right side, but without a distinct tube; the foot terminated by a depressed proboscidiform muzzle; tentacula very distant, with large rings, swollen, as it were, in the lower part of their length, and carrying the eyes at the summit of this enlargement. Mouth terminal, in the form of a vertical slit, without any labial tooth, and with a very small tongue furnished with regularly disposed reflexed teeth. A single straight branchia.



Animal of *Cerithium Telescopium*, and shell of *Cerithium palustre*.

Shell more or less turriculated, tuberculous; aperture small, oval, oblique; the columellar border very much excavated, callous; the right lip sharp-edged, and dilating a little with age. Operculum horny, oval, rounded, sub-spiral, and striated on its external surface; sunk, and bordered on its internal surface.

α.

Species which have evidently a small canal, very short, and obliquely recurved towards the back.

Ex. *C. Vertagus.* Locality, Indian Ocean and Moluccas. (Lamarck.)

β.

Species which have a still smaller canal, but straight throughout, and a well-formed sinus at the posterior union of the two borders.

Ex. *C. Aluco.* Locality, Indian Ocean and Moluccas. (Lam.)

γ.

Species whose aperture is divided into three by the shutting of the short anterior tube, and that of the posterior sinus. (Genus, *Triphore*, or *Tristome* (Deshayes), *Triforis* (?), Deshayes.

Ex. *C. tristoma.*

δ.

Species which have a small straight canal, and the whorls of the spire flat and ribanded, with a deep umbilicus, two decurrent plaits on the columella, and one on the right lip. (Genus, *Nerinea*, Defrance.)

Ex. *C. Nerinea.*

ε.

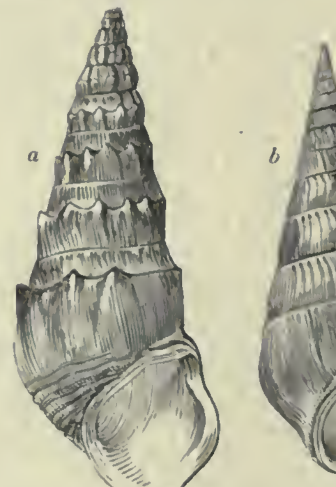
Species which have no canal, but a simple notch, and whose right lip is much dilated in age. (Genus, *Potamides*, Brongniart; *Pyrazus*, De Montfort.)

Ex. *C. palustre.* Locality, coasts of the East Indies, in the salt marshes. (Lam.)

ζ.

Species whose aperture, without a canal, is a little notched in front and rear, the notch being replaced by a sinus; the columellar border curved in its middle; the right lip not dilated. (Genus, *Pirena*, Lam.)

Ex. *C. Madagascariense.*



a, *Cerithium Madagascariense* (Lam.); *b*, *C. Madagascariense* (*Pirena*, Lam.), according to De Blainville. N.B. It is not clear that these are not the same species, notwithstanding the comparative smoothness of *b*.

De Blainville makes the genus *Cerithium*, as established by him, contain 56 species characterised by Lamarck; adding that the greater part are marine, but many from the mouths of rivers, and some entirely lacustrine, and that there is but one belonging to the French seas, whilst more than a hundred fossil species are found in France and Italy. M. Defrance's genus *Nerinea*, he remarks, would be better placed among the *Pyramidellæ*.

The species of this genus with those of *Potamides*, *Nerinea*, *Aporrhais*, and *Struthiolaria*, are often referred to the family *Certhiadæ*, (Woodward, 'Manual of the Mollusca.')

Lamarck places *Cerithium* at the commencement of the first section (Canalifères) of his Zoophagous Trachelipods, immediately after *Turritella*, the last of his Phytophagous (Plant-Eating) Trachelipods.

Cuvier gives it a position after *Purpura*, *Cassis*, and *Terebra*, and before *Murex*. This, as the Rev. M. J. Berkeley and Mr. Hoffman observe, in their interesting paper on the anatomical structure of *Cerithium Telescopium*, would imply a structure of the parts of the mouth adapted for boring shells, according to the known habits of *Murex* and certain allied genera; but, they remark, a single glance at Adanson's figure is sufficient for conviction that the animal is much more nearly allied to the *Trochoides*; and that Lamarck judged rightly, according to the evidence before him, in placing it on the confines of his two great classes. This is corroborated, they add, by the little additional information of M. Sander Rang, who describes the month as toothless, but furnished with a small tongue.

M. Sander Rang states that this genus, so numerous in species both living and fossil, contains only marine animals; but, nevertheless, there are some of them which live at the mouths of rivers, and these are precisely the individuals which M. Brongniart has united to form the genus *Potamides*, which cannot be adopted in Zoology, inasmuch as it does not rest upon sufficiently marked characters. M. Rang adopts generally the divisions of De Blainville with approbation, but he rejects the sixth group (ζ), which comprehends the genus *Pirena*, which Rang, following the example of M. de Férussac, places with *Melanopsis*. Rang agrees with De Blainville in thinking that the division containing Defrance's *Nerinea* is perhaps doubtful, and that its position would be better near the *Pyramidellæ*. He observes that they have in France but two or three living *Cerithia*, but a great number of fossil species.

Deshayes makes the number of living species eighty-seven; not reckoning *Triforis*, of which he gives three species, nor *Pirena*, of which he also gives three; of the latter Lamarck records four. The number of species of *Cerithia* at present described exceed one hundred.

Adanson, speaking of the habits of one of the species of *Cerithium*, says that it lives in the sand amongst grass and mangroves, feeding on 'scolopendres' and other small marine worms. The individual which formed one of the subjects of the investigation by Mr. Berkeley and Mr. Hoffman, and which was brought from Calcutta, though placed in fresh sea-water, the utmost care being taken to renew it frequently, and though all kinds of marine substances were supplied to the animal for food, refused all nourishment, contenting itself with simply walking over the substances, and, in so doing, touching them with its proboscis. As it would not feed, this individual was killed by immersion in spirit. The other specimen, which was anatomised by the zoologists above mentioned, was brought from Ceylon. Dr. J. E. Gray (March 25, 1834) read a note to the Zoological Society of London, giving an account of the arrival in England of two living specimens of *Cerithium armatum*, which had been obtained at the Mauritius, and had been brought thence in a dry state. That the inhabitants of land-shells will remain alive without moisture for many months is, he remarked, well known. [BULINUS.] He had had occasion to observe that various marine *Mollusca* will retain life in a state of torpidity for a considerable time; some facts, in illustration of which, he had communicated to the Society. ('Zool. Proc.,' part i. p. 116.) The present instance included however a torpidity of so long a continuance as to induce him to mention it particularly. The animal, though deeply contracted within the shell, was apparently healthy, and beautifully coloured. It emitted a considerable quantity of bright green fluid, which stained paper of a grass-green colour; it also coloured two or three ounces of pure water. This green solution, after standing twelve hours in a stoppered bottle, became purplish at the upper part; but the paper retained its green colour though exposed to the atmosphere. A specimen of *C. Telescopium*, sent from Calcutta to Mr. G. B. Sowerby in sea-water, lived out of water in a small tin box for more than a week. *Cerithium* has been found in the sea on various bottoms, and in æstuaries at a depth ranging from the surface to seventeen fathoms.

Fossil Cerithia.—Deshayes, in his tables, gives the number of fossil (tertiary) *Cerithia* at 220, and of these he records *C. vulgatum*, *C. Latreillii*, *C. doliolum*, *C. giganteum*, *C. alucaster*, *C. granulosum*, and *C. bicinctum*, as both living and fossil. He gives two fossil (tertiary) species of *Pirena* and two of *Triforis*. The form is found from the Supracretaceous to the Oolitic group, both inclusive. *Potamides* is recorded in the Weald-Clay, Sussex (Mant.); and *Nerinea* in the Oolitic group (Bailly) near Auxerre, St. Mehiel (Meuse), Kimmeridge Clay, Coral Rag, Bernese Jura, Forest Marble, Oxford Oolite, Dorset (*Nerinea Goodhallii*), Inferior Oolite.

Dr. Lea ('Contributions to Geology') describes and figures from the Claiborne Beds, in America, a shell which he names provisionally *Cerithium* (?) *striatum*; observing that he is by no means satisfied in placing this shell among the *Cerithia*. It has a stronger resemblance in the mouth to the genus *Melania*, but being a marine shell, cannot, he remarks, with propriety be placed in that genus. De Blainville, he adds, figures a shell ('Malacologie,' pl. 21, bis, fig. 2), under the name of *Potamides fragilis*, which certainly ought to belong to the same genus with this, the mouth being very nearly the same. Until more species shall be obtained, Dr. Lea has forborne to create for it a new genus. He further states that there have been no *Cerithia* yet found in the beds at Claiborne, although they abound in England and on the Continent in the Tertiary Formation, there being 137 species in the Paris Basin alone. Woodward states that the fossil species exceed 460 in number.

Melanopsis.—Animal furnished with a proboscidiform muzzle, with two contractile, conical, annulated tentacula, having each at their external base an oculated peduncle; foot attached to the neck; respiratory orifice in the canal formed by the union of the mantle with the body. Shell with an epidermis, elongated, fusiform, or conico-cylindrical, with a pointed summit; whorls of the spire from 6 to 15, the last often forming two-thirds of the shell; aperture oval, oblong; columella solid, callous, truncated at its base, separated from the anterior border by a sinus, the callosity prolonged upon the convexity of the penultimate whorl, forming a canal backwards; sometimes a sinus at the posterior part of the right border. Operculum horny, subspiral.

The genus is rather fluviatile than marine, contrary to *Cerithium*, according to De Blainville. Lamarck, who gives but two species, *M. costata* and *M. lævigata*, speaks of them decidedly as fluviatile. Rang says that the genus was established by M. de Férussac for fresh-water shells, whose callous and truncated columella did not permit their arrangement with *Melania*. The latter, in his Monograph, divides them into two groups, the first consisting of those species which have a single sinus at the border of the aperture, separating it from the columella (*Melanopsis*, Lam.; *M. buccinoidea*); the second consisting of those species which have two distinct sinuses at the external border of the aperture, one which separates it from the columella, the other situated near the union of this border with the penultimate whorl. (*Pirena*, Lam.) De Blainville gives the following division of the genus:—

α. Subturriculated Species.

Ex. *M. costata.*

Locality, Syria, in the Orontes. (Lamarck.)

Melanopsis costata.

β. Oval Species.

Ex. *M. buccinoidea.*

γ. Convex Species (Espèces Renflées).

Ex. *M. Bouei.* [MELANOPSIS.]

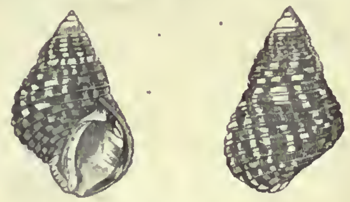
The genus *Melania* is related to *Melanopsis*, and is sometimes included with *Paludomus* in the family *Melaniadæ*. [MELANIA.]

Planaxis.—Animal unknown. Shell oval, conical, solid, transversely furrowed; aperture oblong; columella flattened and truncated anteriorly, separated from the right border or lip by a sinus; right lip furrowed or rayed within, and thickened by a decurrent callosity at its origin. Operculum horny, oval, delicate, subspiral.

Lamarck established this genus for certain small shells approximating closely to the *Phasianellæ*, but differing from them by the truncation of the anterior part of the columella. He only records two species, namely *P. sulcata* and *P. undulata*. M. Rang states that he possesses six well-distinguished species. Woodward, in his 'Manual of the Mollusca,' gives eleven species. They are found in the West Indies, Red Sea, Bourbon, India, the Pacific, and Peru.

The *Planaxis* is a littoral shell, and is sometimes found under stones. M. Rang says that he had had occasion to observe the animal at the Isle of France (Mauritius), where the rocks are sometimes covered with them, but, having lost his notes, he is unable to give its principal characters. According to his recollection, the animal differed very little from that of *Phasianella*. M. Deshayes, in his Tables, puts the living species at four.

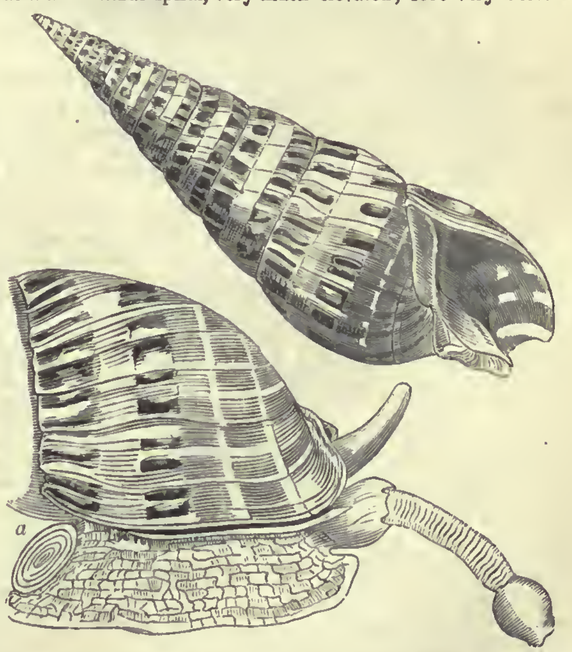
Ex. *P. sulcata.*



Planaxis sulcata.

Deshayes, in his Tables, gives five species as fossil in the Tertiary strata.

Subula.—Animal spiral, very much elevated; foot very short and



Shell of *Subula maculata*, and last whorl of the shell with the animal and operculum *a*.

round; head with extremely small triangular tentacula, bearing the eyes at their summit; a long labial proboscis without hooks (crotchets), at the bottom of which is the mouth equally unarmed. Shell without an epidermis, turriculated, and with a pointed spire; whorls smooth, ribanded, bifid; aperture oval, small, deeply notched anteriorly; external lip thin and sharp-edged; internal or columellar lip with an oblique bourrelet at its extremity. Operculum oval, horny, lamellar, and as it were imbricated.

De Blainville thus characterises a genus which he says he found himself compelled to establish upon examining the animal brought home by Messrs. Quoy and Gaimard, the shell of which had been hitherto confounded with the *Terebræ;* and he arranges under this new genus all those species whose shell is very much elevated, whose spire is very pointed, and whose whorls are ribanded; and consequently the greatest number of the twenty-four living species characterised by Lamarck, and which nearly all belong to the East Indies and Australasia.

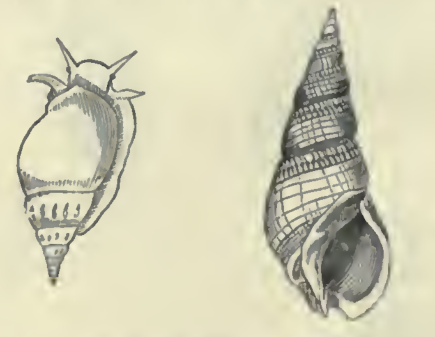
Ex. *S. maculata* (Lam.), *Buccinum maculatum* (Linn.).

It inhabits the Moluccas and Pacific Ocean, according to Lamarck, who speaks of his possession of a specimen taken on the shores of Owhyhee.

** Turbinaceous; or genera whose spire is moderately elongated, rarely subturriculated.

Terebra.—Animal spiral, rather elevated; foot oval, with a transverse anterior furrow and two lateral auricles; head bordered with a small fringe; cylindrical tentacula terminated in a point, and very distant; eyes but little apparent at the origin and outside of the tentacula; mouth without a proboscis; tube of the respiratory cavity very long. Shell without an epidermis, inclining to oval; spire sharp, not much elevated or subturriculated; aperture large, oval, strongly notched anteriorly; columella with an oblique bourrelet at its extremity. No operculum. (De Blainville.)

M. De Blainville only leaves in this genus, which he thinks ought perhaps to belong to the family of non-operculated *Entomostomata*, those species of Lamarck's *Terebræ* which in their general form bear some resemblance to the *Buccina*, such for example as his Vis Buccinée (*Terebra vittata*); because De Blainville supposes that the animal resembles that of the Miran of Adanson, which is the type, and which differs much from that of the subulated species to which De Blainville gives the generic name of *Subula*—Alène in French.



Animal of *Terebra* (Vis Miran) from Adanson, and shell of *Terebra vittata.*

The species, De Blainville observes, appear to come from warm climates only, like the *Subulæ*. *Terebra* (Lamarck) occurs at depths ranging from the surface to 17 fathoms. The species sometimes creep on reefs out of the water, but within reach of the spray.

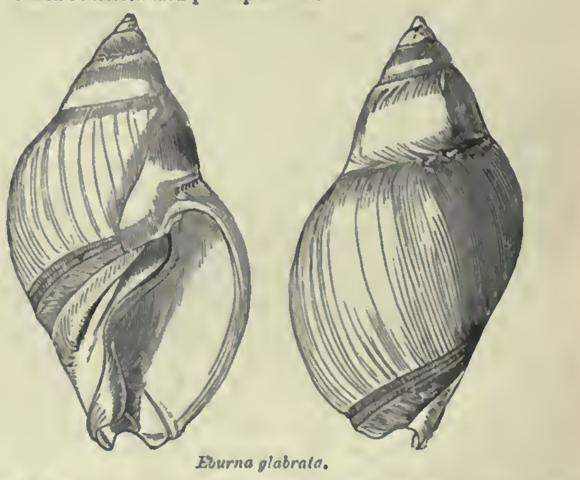
Since the publication of the works of M. De Blainville and of M. Rang, Dr. J. E. Gray has enumerated 45 species, all of them either in the British Museum or in his own private collection. He states that the animal has a small foot, and a very long proboscis, at the base of which are seated two very small tentacula; the operculum is ovate, thin, horny, rounded behind, and rather tapering in front. The shell is covered by a very thin, pellucid, horn-coloured periostraca; it is usually white, variously streaked with brown, the streaks being often interrupted or broken into spots by the two spiral bands of the shell; one of these bands is placed near the spiral groove and the other on the middle of the whorl. The apex of the cavity is frequently filled up by a calcareous deposition; but this deposition has never been observed in *T. duplicata*. Dr. Gray divides the species into the three following sections:—1st. "Anfractibus sulco spirali cingulum posterius efformante; labio interiore, tenui concavo." He observes upon this section that the cingulum is most conspicuous in young shells; and that the internal lip is very rarely thickened in adults. To this section he refers 30 species (*T. maculata*, Lam., &c.), 15 of them new. 2nd. "Anfractibus sulco spirali cingulum posterius efformante; labio interiore incrassato, subelevato." He observes that the species of this section (7, 5 of which are new) somewhat resemble the *Cerithia* in the aperture. 3rd. "Anfractibus sulco postico nullo." These last he divides into two sub-sections, "* with a thin internal lip," which he subdivides into (*a*) those species which have an elongated slender shell, and (*b*) those which have a short shell, and "** with the internal lip thickened and elevated, and the shell short;" and he observes that these approximate somewhat to the *Nassæ*, but have neither the internal dilated lip nor the external thickened lip. This third section contains 8 species, one of which is new.

Dr. Gray does not notice *Subula* of De Blainville, and it may therefore be considered that he does not admit the generic distinction. Woodward makes *Subula* a synonym of *Terebra*, and records 109 recent species.

Fossil Subulæ and Terebræ.—De Blainville refers to his genus *Subula* many of the fossil species which had been considered as *Terebræ*, and which coincide with his definition of the former genus; but he does not enumerate the species, nor draw any distinct line of demarcation between the fossils of these respective genera. He remarks that M. Defrance makes the fossil species of both these genera 17, of which 5 are identical, 3 from Italy, 1 from Grignon, and 1 from Bourdeaux. The 'vis scalarine fossile de l'arnes' De Blainville thinks should be referred to the genus *Terebra*. M. Deshayes, in his Tables, makes *Terebra* (of Bruguière and Lamarck we presume, for he does not notice *Subula*) consist of 44 living species and 16 fossil (tertiary), of which last he considers two new species, and *T. Faval*, *T. strigilata*, and *T. pertusa* to be both living and fossil (tertiary). Dr. Fitton, in his stratigraphical and local distribution of the fossils of the strata below the chalk, records *T. Portlandica* as occurring in the Portland Stone in Dorset, South Wilts, North Wilts, Oxford, and Bucks. Dr. Lea describes and figures three additional species of *Terebra* (Lamarck) from the Claiborne Beds, remarking that 4 species of the genus have been observed in England, 3 in the Oolitic group and 1 in the London Clay. He refers to the 16 species given for the tertiary by M. Deshayes, and says that 10 of these are found at Baden (Miocene) and 7 at Bourdeaux (Miocene). Here is evidently an error in the number. He adds that Mr. Conrad had observed one species, which he calls 'simplex,' in the tertiary of Maryland, "being the only one heretofore observed," adds Dr. Lea, "in our formations." Woodward gives the number of fossil species as 21, and states that they are from the Eocene Beds of Britain, France, and Chili.

Eburna.—Shell oval or elongated, smooth; spire pointed, whorls running together as it were without a marked distinction of suture; aperture inclining to oval, elongated, widened, and deeply notched in front; right lip entire; columella callous posteriorly, umbilicated, subcanaliculated at its external part.

They are found in the seas of warm climates. Of the 9 living species Lamarck refers the locality of three to the East Indies and one to South America and perhaps India.



Eburna glabrata.

Fossil Eburnæ.—De Blainville states in his 'Malacologie' (1825) that no *Eburnæ* had then been discovered in a fossil state. M. Rang remarks (1829) in his 'Manuel' that there are fossil species. Deshayes, in his Tables, records 5 living species and 1 (new species) fossil (tertiary).

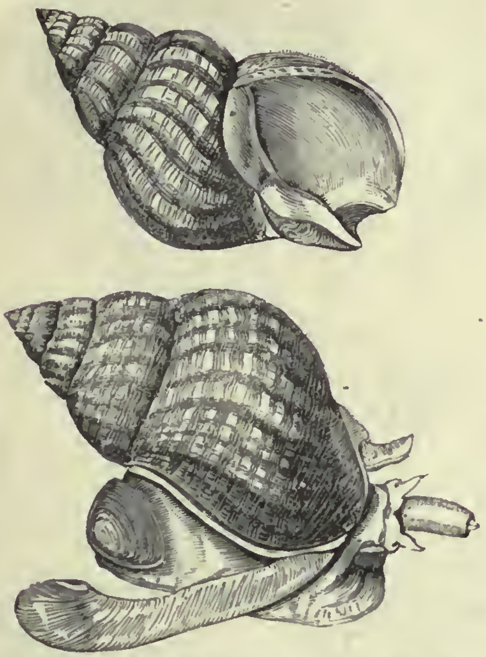
Buccinum.—Shell oval, elongated, with a pointed but moderately-elevated spire; aperture oblong or oval, deeply notched anteriorly; right lip entire, sometimes thick; columella simple or callous; operculum horny, oval, subconcentric; summit but little marked and marginal. [BUCCINUM.]

The geographical distribution is very wide. Species occur in almost all seas. *B. glaciale* and *B. Sabinii* are noted in the 'Supplement to the Appendix of Captain Parry's First Voyage' as having been met with during the period in which the expedition remained within the arctic circle.

The species are very numerous, and have been found at depths ranging from the surface to 17 fathoms. The greater part of the genus is littoral.

De Blainville subdivides the species into many sections comprehending the true *Buccina*, including the genera *Alectrion* (*B. papillosum*) and *Cyclops* (*B. neriteum*) of De Montfort, and the genus *Nassa*, Lamarck. M. De Férussac divides the genus into two sub-genera, namely, the *Buccina* properly so called, of which *B. undatum* may be considered the type, and the *Eburnæ*. M. Sander Rang adopts his arrangement. We confine ourselves to the true *Buccina*.

Ex. *B. undatum*, the Common Whelk. This is the species so commonly exposed for sale as food on the street stalls in the metropolis.



Shell of Common Whelk (*Buccinum undatum*), and animal (male) creeping with its shell and operculum.

B. Lapillus (*Purpura*) is one of the English shells that produce the purple dye, analogous to the *Purpura* of the ancients; and Mr. William Cole, of Bristol, thus describes (1684) the process of obtaining the English *Purpura*:—"The shells being harder than most of other kinds are to be broken with a smart stroke with a hammer, on a plate of iron or firm piece of timber (with their mouths downwards), so as not to crush the body of the fish within; the broken pieces being picked off there will appear a white vein, lying transversely in a little furrow or cleft next to the head of the fish, which must be digged out with the stiff point of a horsehair pencil, being made short and tapering. The letters, figures, or what else shall be made on the linen (and perhaps silk too) will presently appear of a pleasant light green colour, and if placed in the sun will change into the following colours, that is, if in winter about noon; if in the summer an hour or two after sun-rising, and so much before setting; for in the heat of the day in summer the colours will come on so fast that the succession of each colour will scarcely be distinguished. Next to the first light green it will appear of a deep green, and in a few minutes change into a sea green; after which, in a few minutes more, it will alter into a watchet-blue; from that, in a little time more, it will be of a purplish-red; after which, lying an hour or two (supposing the sun still shining), it will be of a very deep purple-red, beyond which the sun can do no more. But then the last and most beautiful colour, after washing in scalding water and soap, will (the matter being again put into the sun or wind to dry) be of a fair bright crimson, or near to the prince's colour, which afterwards, notwithstanding there is no use of any stiptic to bind the colour, will continue the same, if well ordered, as I have found in handkerchiefs that have been washed more than forty times; only it will be somewhat allayed from what it was after the first washing. While the cloth so writ upon lies in the sun it will yield a very strong and fœtid smell, as if garlic and asafœtida were mixed together." ('Phil. Trans.,' Abr. II. 826.)

We have inserted this account here, because the shell which is the subject of it may be more familiar to our readers under the Linnæan name of *Buccinum Lapillus* than of *Purpura Lapillus*, but it is properly arranged under the genus *Purpura*.

Fossil Buccina.—M. Deshayes, in his Tables, makes the number of fossil (tertiary) species 95, and he records the following as both living and fossil (tertiary), *Nassa* not appearing as a genus in his list—*B. undatum, reticulatum, maculosum, mutabile, clathratum, neriteum, Desnoyersi, prismaticum, asperulum, musivum, inflatum, polygonum, D'Orbignii, Linnæi, politum*, and five new species, the names of which are not given. Dr. Fitton notes two species below the Chalk, namely, *B. angulatum* and *B. naticoide* in the Portland Stone (North Wilts, South Wilts, Bucks), and the last-named species in the Portland Sand (Bucks). Dr. Lea notes one species (new), *B. Sowerbii*, in the Claiborne Beds, Alabama. He observes that of the genus 27 species, including *Nassa*, have been observed in Great Britain, several as low as the Mountain Limestone, but chiefly in the London Clay and the Crag. After repeating the number given by Deshayes, Dr. Lea says that the genus appears to be much more abundant in the upper formations. The Pliocene of the Sub-Apennines furnishes 27 species. Bourdeaux (Miocene) 21 species. Paris (Eocene) 9 species. In America, he adds, four species have been found, Mr. Say having described two from the older Pliocene, Maryland, and Mr. Conrad two from York Town, Virginia, also older Pliocene. The fossil species now known, including those of *Purpura*, are about 150.

Nassa.—Animal very much depressed, with a very large foot extending beyond the body on all sides, but especially in front, where it is large and angular, whilst posteriorly it is insensibly narrowed. For the rest like the animal of *Purpura*. Shell globular, oval, or subturriculated; aperture oblong, notched anteriorly; right lip sharp-edged, often plaited within; columellar lip covered with a large callous plate, extending more or less far. Operculum horny.

Dr. Lea ('Contributions to Geology') says, "I have not hesitated to separate this genus from *Buccinum* (although Lamarck united them after having made the division), because they certainly form a very natural group. Cuvier separates it, as De Blainville also does, into a sub-genus." De Blainville certainly makes one of his sections of *Buccinum* consist of the genus *Nassa*; but Rang separates it decisively.

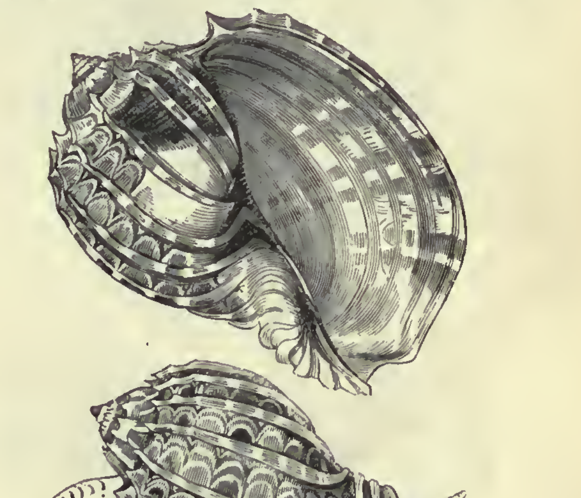
The species of *Nassa* have a world-wide distribution, being found in arctic, tropical, and antarctic seas. They have been found on reefs, coral sand, sand, sandy-mud, and under stones, at depths ranging from the surface to 15 fathoms. About 70 species are known. *N. reticulata* is common on English shores, and called the Dog-Whelk by fishermen. [NASSA.]

Fossil Nassæ.—The species of Fossil *Nassæ* are above 20. They are found in the Eocene Strata of Britain and North America.

*** Ampullaceous *Entomostomata*, or those whose shells are in general globular.

Harpa.—Animal with a large head, without a proboscis, having the mouth opened below; two anterior tentacula, conical, and very much approximated, carrying the eyes upon an enlargement situated externally a little below the middle; foot large, furnished anteriorly with a sort of heel; siphon rather large and a little elongated; branchial pectinations unequal, two in number; orifice of the oviduct at the entrance of the branchial cavity of the right side, orifice in the deferent canal at the extremity of a very voluminous excitatory organ; vent on the same side.

Shell oblong, more or less convex, generally rather delicate, enamelled, furnished with regular longitudinal ribs; spire a little elevated and pointed, the last whorl very large; aperture oval, elongated, widely notched anteriorly, the right lip with an external bourrelet; columella simple, pointed anteriorly. No operculum, according to M. Reynaud.



Shell of *Harpa ventricosa*, and animal crawling with its shell.

The genus is found in the seas of warm climates, and is more especially abundant at the Mauritius and the neighbouring islands, whence the finest of the more common species and the many-ribbed Harps are procured. The animal is said to be of a rich vermilion red. The fishery is principally carried on at low water with a small rake, to which a net is attached, on sand-banks at night, and at sunrise when the Harps are probably out upon their feed. They have been known to take the bait on the fishing-lines laid for olives (*Oliva*). Messrs. Quoy and Gaimard, and afterwards M. Reynaud state, that the animal of the Harp can sometimes, when attacked by an enemy, disembarrass itself of the posterior part of the foot, and completely withdraw itself into the shell. M. Reynaud explains this phenomenon by giving his opinion that the tranverse laceration which causes, in the movement of contraction exerted by the animal, the separation of the posterior part of the foot, arises from the resistance which that part, too voluminous to enter the shell after the animal, encounters from the edges of the shell. M. Rang observes, that though no operculum has been found (and the animal appears to have been carefully examined), he does not hesitate to leave the genus among those which are provided with one, because, in the first place, *Harpa* is similarly organised, and, in the next, if deprived of that appendage, it has, at least, the posterior part of the foot to take, in some sort, its place.

Authors generally make the number of living species eight, and of these the most precious, though lately greatly depressed in value, is the Many-Ribbed Harp (*H. imperialis*). But some of the species are very difficult of definition, though others are well marked. The shells when in fine condition are great favourites with collectors, and indeed a drawer of fine Harps in all the freshness of their beauty is a sight worth seeing. Care should be taken to keep them with their mouths downwards and from the sun and light, or their brilliant colours will soon fade.

Ex. *H. ventricosa*. Locality, Mauritius, &c.

Fossil Harpæ.—Four species are recorded, in the Tertiary Formation.

Dolium.—Animal generally resembling that of *Purpura*. Shell delicate, nearly globular, ventricose, furrowed transversely; spire but little elevated, pointed, the last whorl forming nearly the whole of the shell; aperture large, oval, right lip undulated. Columella often twisted; operculum horny.

The species are found in the seas of warm climates, especially those of India. They are also found in Australia and the Pacific. One species, *D. galea*, inhabits the Mediterranean. The species are often found on reefs, some of them are very large. Fourteen seems to be the greatest number hitherto recorded, and Cuvier has separated the species into two sections, namely the Tuns (*Dolium*) and the Partridge Tuns (*Perdix* of De Montfort.)

Ex. *D. galea*, and *D. perdix*.

Shell of *Dolium galea*, and animal denuded (diminished).

Fossil Dolia.—Seven species are recorded as fossil. They are found in the Miocene Tertiary Beds.

Cassidaria.—Animal supposed to bear a general resemblance to that of *Buccinum* and *Purpura*. Shell ovoid, ventricose, with the spire but little elevated; aperture long, rather narrow, with the anterior canal recurved; right lip furnished with a bourrelet; columellar lip covered by a large callosity, often granulous or wrinkled. Operculum horny.

The seas of comparatively warm climates. Lamarck gives the Mediterranean as the locality of two species. Rang states that only one species is European. De Blainville speaks of the genus as inhabiting all seas except that of the north.

The number of living species recorded appears to be seven.

Ex. *C. echinophora*. Locality, the Mediterranean.

Cassidaria echinophora.

Fossil Cassidariæ.—Deshayes, in his Tables, gives 8 fossil (tertiary) species; and of these, two, namely *C. echinophora* and *C. Tyrrhena*, he records as both living and fossil (tertiary). The number of fossil species is about ten. They are found in the Eocene Beds of Great Britain and France.

Oniscia.—A genus separated from *Cassidaria* by Mr. G. B. Sowerby, and considered by him as having its place next to that genus in the natural system. It differs from *Cassis* in the canal not being suddenly reflected; but Mr. Sowerby states that he has seen *Cassides* which very nearly approach *Oniscia* in the form of the aperture, and in the short scarcely reflected canal. He thinks that the genus is intermediate between *Cassidaria* and *Cassis*.

Shell oblong, sub-cylindrical, apex generally rather obtuse, spire short, sometimes very short; base rather acuminated; aperture longitudinal, elongated, extending at the base into a very short canal: outer lip thickened, denticulated within, and rather contracted in the centre; inner lip expanded and covered with granules. (Sowerby.) The outside of the shell is tuberculated, cancellated, or ribbed. "Of the animal," says Mr. Sowerby, "we know nothing; but there is every reason for believing it to be related to that of *Cassis*, and that it has an operculum, though we have never seen it."

Six living species are recorded, from the West Indies, China, and the Galapagos.

Ex. *O. cancellata*.

Oniscia cancellata, adult.

Three fossil species are recorded, from the Miocene Beds of the Tertiary Strata.

Cassis.—Animal said to resemble generally that of *Purpura*. Shell inclining to oval, convex, with a spire but little projecting, nearly flat; aperture oblique, long, and narrow, with the anterior canal very short and recurved towards the back; right lip thick, furnished with an external bourrelet, and toothed within; columellar lip callous, nearly straight, and marked nearly throughout its length with transverse long teeth. Operculum horny, very rudimentary.

The species occur principally in very warm latitudes in shallow water: two or three are said to be found in the Mediterranean.

The number of living species is about thirty-four. These are divided into two groups by Lamarck; the first consisting of those species whose spire is marked by bourrelets (*C. cornuta*, for example); and the second of those whose spire is without bourrelets (*C. rufa*, for example).

De Blainville divides the species into two groups also; the first consisting of those whose aperture is long, and the external lip nearly straight (*C. tuberosa*, for example); the second of those whose aperture is suboval, and the external lip excavated (*C. flammea*, for instance).

Ex. *C. tuberosa*. Locality, West Indian Seas.

Fossil Cassides.—The number of fossil (tertiary) species is 36; of these are *C. flammea*, *C. granulosa*, *C. crumena*, *C. saburon*, *C. bisulcata*, and a new species, both living and fossil (tertiary).

Shell of *Cassis tuberosa*; and animal denuded of *Cassis sulcosa* (diminished).

The fossil species are principally found in France and Chili.

Ricinula.—Animal nearly entirely resembling those of *Buccinum* and *Purpura*. Mantle provided with a tube; foot much wider, and auriculated, as it were anteriorly; head semilunar, with conical tentacula, supporting the eyes at the middle of their external surface; excitatory organ of the male very large, recurved in the branchial cavity. Such is De Blainville's description, who made his observation on 'la Ricinule horrible,' *R. horrida*.

Shell oval or sub-globular, thick, beset with points or tubercles, with a very short spire; aperture narrow, long, with a notch (which is sometimes sub-canaliculated) anteriorly; right lip often digitated, externally and toothed within; the left lip callous and toothed or wrinkled. Operculum horny, oval, transverse, concentric. De Blainville describes the elements of the operculum as a little imbricated.

There are 29 species of this genus. They are from India, China, the Philippines, Australia, and the Pacific.

The species have been found on coral reefs and rocks.

De Blainville separates the species into three sections: the first consisting of those with an evident canal anteriorly and behind the aperture (en arrière de l'ouverture), *R. digitata*; the second of those without a canal and beset with spines, *R. horrida*; and the third of those without a canal and tuberculous, *R. morus*. He observes that this genus is evidently artificial: thus it contains one species which is a true *Murex*, whilst others are closely approximated to certain species of *Turbinella*; in fact, they have two or three plaits on the columella; finally, some of them scarcely differ, he says, from the true *Purpuræ*.

Ex. *R. horrida*.

Ricinula horrida.

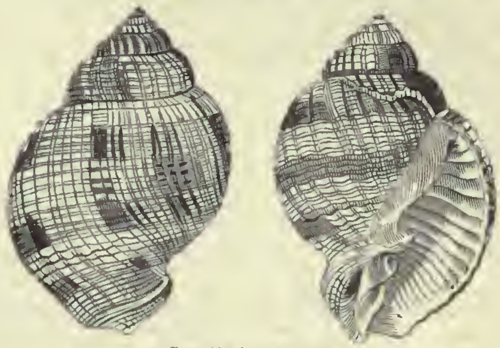
Three Fossil *Ricinulæ* have been recorded.

Cancellaria.—Animal said to resemble generally that of *Purpura*. Shell oval or globular, rather convex, reticulated, thick, with a spire slightly elevated and pointed; aperture demioval, notched or subcanaliculated anteriorly; right lip sharp-edged, striated within; columella nearly straight, with many well-defined plaits. Operculum horny.

The species are all exotic, and the inhabitants of warm seas. The localities of the bulk of those known are said by De Blainville to be inhabitants of the Indian and African seas. The species have been found on sandy bottoms, at a depth ranging from 7 to 16 fathoms.

De Blainville observes that the genus as adopted by him is not entirely the same as that of Lamarck. De Blainville withdraws from the genus the species whose aperture is evidently canaliculated, such as *C. senticosa*, which, as it appears to him, ought to remain among the *Murices* or the turriculated *Turbinellæ*. Deshayes, in his Tables, makes the number of living species 13. Mr. G. B. Sowerby ('Zool. Proc.,' 1832) describes 22 new species from the collection of Mr. Cuming, most of them from the warm latitudes of the Pacific side of South America. One of them, *C. uniplicata*, dredged in sand near Panama at a depth of 10 fathoms, is the only species known to Mr. Sowerby with a single fold on the columella. Woodward ('Manual') gives 70 recent species.

Ex. *C. reticulata*. Locality, Southern Atlantic Ocean. (Lamarck.)



Cancellaria reticulata.

Fossil Cancellariæ.—Lamarck records 7 fossil species. Rang says there are a good number. De Blainville observes that, according to Defrance, there are 20 species, two of which are identical, one from Italy, the other from Grignon, and one analogue from Italy. Deshayes makes the number of fossil (tertiary) species 42, one of which he notes as both living and fossil (tertiary). Dr. Lea describes and figures, in addition, 8 species from the Tertiary Formation of Alabama (Claiborne). He observes that the genus has been observed in England only in the London Clay, whence three species have been described; and, referring to Deshayes's Tables and his 42 species, remarks that 16 are from the Sub-Apennines (Pliocene), 12 from Bourdeaux (Miocene), and 5 from Paris (Eocene). In America, he observes, a single species only, *C. lunata* (Conrad), had been theretofore observed. It was from the Tertiary Beds of Saint Mary's. Woodward gives 60 species, all Eocene.

Purpura.—Animal rather elongated, widened in front; head large with a very short proboscis; two tentacula, generally in front and approximated, conical, and supporting the eyes on an enlargement situated at the middle of their external part; mouth below, nearly always hidden by the foot, which is rather large, very much advanced, and bilobated, as it were, anteriorly; branchial pectinations two, unequal; orifice of the oviduct at the entrance of the branchial cavity on the right side; orifice of the deferent canal at the right side of the neck, at the extremity of the exciting organ, which is generally voluminous; vent on the same side.

Shell of *Purpura Persica*, and animal of *Purpura hæmostoma*.

Shell oval, thick, unarmed or tubercular, with a short spire, the last whorl larger than all the others together; aperture very much dilated, of an oval form, terminated anteriorly by an oblique notch;

columella flattened, finishing in a point anteriorly; right lip sharp-edged, often thickened and furrowed internally, or strongly armed anteriorly with a conical point. Operculum horny, demicircular, the summit posterior.

The form is widely distributed, but the number of European species is very small; the greatest development takes place in warm seas, where the species are most abundant, particularly in South America. The larger proportion of the species of this genus are littoral. The true *Purpuræ* have been found at depths ranging from the surface to 25 fathoms, and the division which forms the genus *Monoceros*, generally on rocks, at depths ranging from the surface to 7 fathoms.

De Blainville states that there are 50 living species of ordinary *Purpuræ*, of which four only belong to the French seas. The species of *Monoceros* he states to be five, all from South America. Deshayes, in his Tables, gives 76 as the number of living species of the genus *Purpura* (Lam.), and 6 as that of the living species of *Monoceros*. Dr. Lea states that his cabinet has nine. Mr. Broderip describes two new species, and Mr. Powys one, from Mr. Cuming's collection (Port St. Elena, Valparaiso, and Maldon Island, in the Pacific), and Mr. Broderip another, *Purpura Gravesii*, figured under the name of *Murex cariniferus*, in Mr. Sowerby's 'Conchological Illustrations.' ('Zool. Proc.') Mr. Sowerby describes nine species of *Monoceros*, among them *M. punctulatum* (Gray), from Mr. Cuming's collection. Woodward puts down the species at 140.

De Blainville divides the species into four sections:—1st. Those whose right lip, near the notch, is armed with a conical horn, or tooth, which is pointed, and more or less curved. This section is the genus *Monoceros* (De Montfort), the animal of which, according to M. Rang and others, differs in nothing from that of the other *Purpuræ*. 2nd. The Buccinoid *Purpuræ*, whose lip is without a tooth, and whose aperture is moderately widened. *Purpura Lapillus* (*Buccinum Lapillus*, Linn.), for example. (See above, *Buccinum*.) 3rd. The Patulous *Purpuræ*, also without a tooth at the lip, and whose aperture is very wide: *Purpura Persica* for instance. 4th. The ventricose tuberculated species, of which he gives *P. neritoides* as the type. M. Rang divides the species into two groups only. The first, consisting of those which have the right lip simple, or only furrowed internally: the second, of those whose right lip is always thickened and armed anteriorly with a conical point.

Example of the first, *Purpura Persica*. Locality, East Indian seas.

Example of the second, *Purpura imbricata* (*Monoceros imbricatum*, Lam.). Locality, South America.

Purpura imbricata (*Monoceros imbricatum*, Lam.).

Fossil Purpuræ.—De Blainville states ('Malacologie') that no fossil species of *Monoceros* were then known. Deshayes, in his Tables, records one (tertiary) from Italy. Dr. Lea describes and figures three new fossil species from the Tertiary of Claiborne, Alabama (Eocene of Lyell). Of the ordinary *Purpuræ* De Blainville states that there are nine fossil species, one of which is the analogue of *P. Lapillus* (*Buccinum Lapillus*, Linn.), so common on our coasts, as well as those of France. Deshayes, in his Tables, gives the number of fossil (tertiary) species as four, of which he records one, *P. hæmastoma*, as both living and fossil. Woodward states the fossil species to be thirty.

**** Patelloid *Entomostoma*; that is, one whose shell is very large in its totality, very flattened, with a spire but little marked, and without a columella.

Concholepas.—De Blainville speaks of the animal as entirely unknown; but according to Lesson it resembles that of *Purpura*. Shell thick, rude, and wrinkled transversely on its external surface: spire very small, hardly projecting; aperture oval, very large, notched anteriorly, where there are two dentiform appendages; no columella; muscular impression of a horse-shoe shape, and very visible. Operculum horny, transparent, trapezoidal, concentric, with a marginal summit.

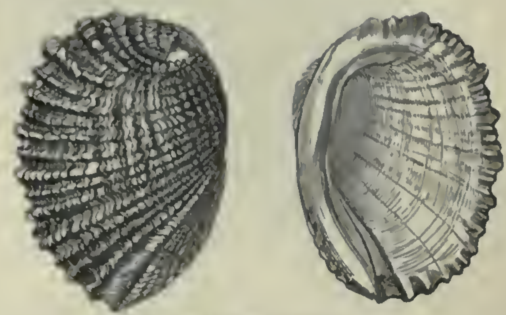
South America is the locality of *Concholepas*. It is very abundant on the coasts of Peru and Chili, and sometimes attains to a very large size.

Concholepas is only known as a littoral species.

Lamarck first placed *Concholepas* near *Purpura*. Cuvier gives it very nearly the same position. M. Rang remarks that he might have well united the genus to *Purpura*, after the example of De Férussac. In fact, he adds, M. Lesson's communication touching the animal which the latter brought home from the South Sea had proved to M. Rang that it differs in nothing from that of *Purpura*; its operculum alone affords a well-defined character.

There is but one species known; but M. Rang states that there are two distinct varieties.

Ex. *C. Peruviana*.



Concholepas Peruviana.

Concholepas is not known in a fossil state, properly so called. It occurs among other species of the coast at considerable elevations above the sea.

ENTOMO'STRACA (Müller), *Shell Insects*, for such is the meaning of the term applied to certain Aquatic Animals forming, according to Latreille and others, the second general division of the Crustaceans, and for the most part inhabiting the fresh-water. The brain, or rather the nervous knots which supply its place, consists of one or two globules merely. The heart is in the form of a long vessel. The branchiæ, composed of hair-like processes, which are either isolated or connected in a beard-like form, a pectinated shape, or one resembling aigrettes, form a portion of the feet, or of a certain number among them, and sometimes mandibles and the upper jaws. [CYPRIS; BRANCHIOPODA.] The number of the feet varies, and in some of the genera is above a hundred. These feet, ordinarily, are proper for no purpose but swimming; and are sometimes ramified or divided, and sometimes furnished with pinnules, or composed of lamellar joints. Nearly all of them have a shell, consisting of from one to two pieces, very delicate, and most frequently almost membranous and transparent, or at least a large anterior thoracic segment, often confounded with the head and appearing to replace the shell. The integuments are generally rather horny than calcareous, a condition which, as Latreille remarks, approximates the Entomostracans to the Insects and Arachnids. In those which are provided with ordinary jaws, the inferior or external ones are always uncovered, all the jaw-feet (pieds-mâchoires) performing the office of true feet, and none of them being applied upon the mouth. The second jaws, with the exception of the *Phyllopoda*, resemble those organs, and Jurine has sometimes designated them under the name of hands. These characters, says Latreille, distinguish the Masticating *Entomostraca* (Entomostraces Broyeurs) from the *Malacostraca*; the other *Entomostraca* which compose his order *Pœcilopoda* cannot, he says, be confounded with the *Malacostraca*, because they are deprived of organs fit for mastication, or because those parts which appear to perform the office of jaws are not collected anteriorly and preceded by a labrum as in the true *Crustacea* and the Masticating Insects (Insectes Broyeurs), but simply formed by the haunches of the locomotive organs, and furnished, for the purpose of enabling them to execute that office, with small spines. The *Pœcilopoda*, he observes, represent in this class those of the class of insects which are denominated Suctorial (Suceurs). They are almost all parasites, and seem to lead us by degrees (par nuances) or shades of difference to the *Lernææ*; but the presence of eyes, the property of moulting or changing the skin, or even of undergoing a metamorphosis, and the faculty of being able to transport themselves from one place to another by means of feet, appear to Latreille to establish a well-defined line of demarcation between the animals last named and the preceding. With regard to the metamorphosis, he remarks, that the young of the *Daphniæ* and of some other nearly allied genera, those probably also of *Cypris* and of *Cytherina*, differ not at all or scarcely at all from their parents, in point of form, at the time of their exclusion from the egg; but the young of *Cyclops*, of the *Phyllopoda*, and of *Argulus*, undergo in their infancy remarkable changes, as well in the form of the body as in the number of feet. These organs indeed in some (in the *Arguli* for instance) suffer transformations which modify their uses. The same author states that he has consulted, relative to these transformations, several well-informed naturalists, who have had frequent occasion to observe the *Lernææ*, and that those observers had never seen a *Lernæa* change its skin. The antennæ of the *Entomostraca*, the form and number of which vary much, serve in many for swimming. The eyes are very rarely placed upon a pedicle, and when they are so placed the pedicle is no more than a lateral prolongation of the head, and is never articulated at its base. The last-named organs are often very much approximated, and even compose one only. The tail is never terminated by a fan-shaped fin, and never presents the false feet of the *Malacostraca*. The eggs are collected under the back, or external, and under a common envelope, having the form of one or two small groups situated at the base of the tail. They possess the power of preserving their vitality for a long time in a state of desiccation. [BINOCULUS.] It would appear that not less than three moults are undergone by many of these animals before they become adult and capable of propagating their species, and it has been proved, in the case of some of them, that a single copulation will fecundate many successive generations. [BRANCHIOPODA.] Dr. Baird, in his interesting Monograph on the British *Entomostraca*, gives the following general account of this family :—

"The greater number of these little creatures are furnished with branchiæ, either to their feet or maxillæ, and when noticed in their native habitats, may be seen to have them constantly in motion, their action being seldom interrupted. One chief use therefore of them in the economy of nature may be, as Müller says, to ventilate the water day and night; and as they chiefly reside in standing pools, they may thus be of great use in preventing them from becoming soon putrid.

"As this may be considered one of the benefits conferred by these insects, it may be useful to know the evils to man they may be likely to produce.

"Though they are most abundant in stagnant water, they yet occur in considerable numbers in the purer sorts of water that serve as our common drink, and may frequently be seen even in the drinking water of London, Edinburgh, and other large towns; and Müller asserts very gravely, that as we thus drink them alive, and with their eggs, he would not be surprised were we to discover them some day in the human intestines. 'The time,' he says, 'is at hand, when the causes of disease shall not only be sought after in the air, in our method of living, &c., but in the incautious use of waters often abounding in innumerable animalcules.' According to Müller and Straus, the greater number of the *Entomostraca*, not parasitical, live upon vegetable matter, and not upon animals; and the former, in an experiment he instituted, says, that in keeping a number of species, such as the *Daphnia pennata* and *longispina*, *Cypris strigata* and *pilosa*, *Lynceus sphericus*, and *Cyclops quadricornis*, in the same water from the 24th of July to the 22nd of January, during which time the water had evaporated from a depth of five inches to that of one, he frequently subjected small quantities of this water to the microscope, and he was never able to discover any animalcules in it upon the most attentive examination, though the intestines of the *Entomostraca* themselves were seen to be full, sufficiently proving that they had not fasted during that time. This assertion however I am much inclined to call in question. The *Cyprides* particularly seem to be most voraciously carnivorous; and I have invariably found it exceedingly difficult to keep for a length of time any other *Entomostraca* alive in the same vessel with the larger species of *Cypris*. In a vessel, in which I have kept full grown *Chirocephali*, there were mixed with them many specimens of the *Cypris tristriata*. In a few days the *Chirocephali* might be seen to become languid in their movements, and assume an unhealthy appearance. The *Cyprides* had become their deadly enemy. They might be seen ever and anon to fasten themselves to the delicate feet of the poor *Chirocephali*, and wofully impede their course through the water; and when, either from these annoyances, or from any other cause, they ceased to be able to move with any degree of rapidity, hosts of these little *Carnivora* might be observed to attack them before life was extinct, anticipating as it were their victims' death. Then, when life had fairly ceased, they rioted upon their flesh, and in a few hours little but the external covering was left.

"I have no doubt that most of the *Entomostraca* are essentially carnivorous, and I have frequently seen specimens of *Cypris* in their turn, as soon as dead, attacked immediately by quantities of the *Cyclops quadricornis*, who in a few minutes had fastened themselves upon the dead animal, and were so intent upon their prey that they were scarcely frightened away from it by being touched with a brush. In a short time the *Cypris* might be seen lying at the bottom of the vessel, the valves of the shell separated and emptied of their contents. Leuwenhoek and De Geer not only maintain that the *Cyclops quadricornis* lives upon animalcules, but that it even preys upon its own young, a fact which I have also noticed myself. Jurine asserts that the *Cyclops quadricornis* is carnivorous from taste, and only herbivorous from necessity; while the *Daphnia pulex*, he distinctly affirms, lives upon animalcules. Place a few *Entomostraca*, such, for example, as the *Daphniæ*, *Chirocephali*, *Lyncei*, &c., in a vessel with clear pure water, and only some vegetable matters in it, and they gradually become languid, transparent, and finally die; but mix with this water some which contains numerous *Infusoria*, and the *Entomostraca* will then be seen speedily to assume another aspect. They become lively and active, and the opacity of their alimentary canal testifies sufficiently the cause of it. When indeed we consider the amazing quantity of animals which swarm in our ponds and ditches, and the deterioration of the surrounding atmosphere which might ensue from the putrefaction of their dead bodies, we see a decided fitness in these *Entomostraca* being carnivorous, thus helping to prevent the noxious effects of putrid air which might otherwise ensue; whilst they in their turn become a prey to other animals, which no doubt serve their purposes also in the economy of nature.

"The fresh-water *Gammari* seem to prey upon them, and the *Hydrachnæ* are their decided enemies; 'for,' says Müller, 'they seize hold of them while swimming by their feet, and daintily suck the life's blood out of their captives with their sharp beaks. The *Hydræ* also, and not a few aquatic larvæ, lay snares for them; and many *Vorticellæ* frequently greviously infest them, for they not only adhere (often in heaps) to the members projecting beyond the shell, but they overspread the whole body with their own colonies, not a little retarding the motion and agility of their host.' The larva of the *Corethra plumicornis*, known to microscopical observers as the Skeleton Larva, is exceedingly rapacious, more especially of the *Daphniæ*. They seize their prey with the rapacity of a pike, grasping it with their two strong jaws and gorging it alive. Pritchard says they are the choice food of a species of *Naia*, which he calls the *Lurco*, and which devours them in great numbers. The *Chydorus sphericus* is their especial favourite, and I have repeatedly verified Pritchard's observations, having counted at least ten individuals swallowed alive, and lodged in the different stomachs of this glutton. Those in the first and second stomachs were still alive, while those contained in the inferior ones were more or less partially decomposed.

"The marine species are also preyed upon by their different enemies, amongst which are the *Beröes*. 'The fact of *Beröes* feeding upon small *Crustacea*,' says Mr. Paterson, 'has been recorded by Fabricius, and at present appears to rest upon his authority. It was interesting to observe the fact, which I did, without knowing it was previously known. The *Crustacea* were almost as visible in the transparent body of the *Beröe* as they had previously been, and very conspicuous by the bright green of their colouring.'

"That the *Entomostraca* form a considerable portion of the food of fishes has been long observed, and it is very probable that the quality of some of our fresh-water fishes may in some degree depend upon the abundance of this portion of their food. Dr. Parnell informs us that the Loch Leven trout owes its superior sweetness and richness of taste to its food, which consists of small shells and *Entomostraca*. The colour of the Loch Leven trout, he farther informs me, is redder than the common trout of other localities. When specimens of this fish have been removed from the Loch and conveyed to lakes in other places, the colour remains, but they very soon lose that peculiar delicacy of flavour which distinguishes so remarkably the trout of Loch Leven. The experiment has been repeatedly tried, and always with the same results. The Bansticle devours them with great rapidity; and I have seen two or three individuals clear in a single night a large basin swarming with *Daphniæ*, *Cyclops*, &c."

The following is the arrangement of this family adopted by Dr. Baird :—

Sub-Kingdom ANNULOSA.

Class CRUSTACEA. Division ENTOMOSTRACA.

Legion I. BRANCHIOPODA. [BRANCHIOPODA.]

Order I. PHILLOPODA.

Family 1, APODIDÆ, containing one genus	*Apus*.
Family 2, NEBALIADÆ, containing one genus	*Nebalia*.
Family 3, BRANCHIPODIDÆ, containing two genera	*Chirocephalus*. [CHIROCEPHALUS.] *Artemia*. [ARTEMIA.]

Order II. CLADOCERA.

Family 1, DAPHNIADÆ, containing six genera	*Daphnia*. [DAPHNIA.] *Moina*. *Bosmina*. *Macrothrix*. *Sida*. *Daphnella*.
Family 2, POLYPHEMIDÆ, containing two genera	*Polyphemus*. *Evadne*.
Family 3, LYNCEIDÆ, containing seven genera	*Eurycercus*. *Chydorus*. [CHYDORUS.] *Camptocercus*. *Acroperus*. *Alona*. *Pleuroxus*. *Peracantha*.

Legion II. LOPHYROPODA.

Order I. OSTRACODA.

Family 1, CYPRIDIDÆ, containing five genera	*Cypris*. *Candona*. *Cythere*. [CYTHERE.] *Cythereis*. *Cypridina*.

Order II. COPEPODA.

Family 1, CYCLOPIDÆ, containing four genera	*Cyclops.* *Canthocamptus.* *Arpacticus.* *Alteutha.*
Family 2, DIAPTOMIDÆ, containing three genera	*Diaptomus.* *Temora.* *Anomalocera.*
Family 3, CETOCHILIDÆ, containing one genus	*Cetochilus.*
Placed here provisionally, genus .	*Notodelphys.*

Legion III. PŒCILOPODA. [PŒCILOPODA.]

Order I. SIPHONOSTOMA.

Tribe 1. PELTOCEPHALA.

Family 1, ARGULIDÆ, containing one genus	*Argulus.* [ARGULUS.]
Family 2, CALIGIDÆ, containing four genera	*Caligus.* [CALIGUS.] *Lepeoptheirus.* *Chalimus.* *Trebius.*
Family 3, PANDARIDÆ, containing two genera	*Dinemoura.* *Pandarus.*
Family 4, CECROPIDÆ, containing two genera	*Cecrops.* *Læmargus.*

Tribe 2. PACHYCEPHALA.

Family 1, ANTHOSOMADÆ, containing one genus	*Anthosoma.*
Family 2, ERGASILIDÆ, containing one genus	*Nicothoë.*

Order II. LERNEADÆ. [LERNEADÆ.]

Tribe 1. ANCHORASTOMACEA.

Family 1, CHONDRACANTHIDÆ, containing two genera . .	*Chondracanthus.* *Lernentoma.*

Tribe 2. ANCHORACARPACEA.

Family 1, LERNEOPODODÆ, containing one genus . . .	*Lerneopoda.*
Family 2, ANCHORELLADÆ, containing one genus . . .	*Anchorella.*

Tribe 3. ANCHORACERACEA.

Family 1, PENELLADÆ, containing one genus	*Lerneonema.*
Family 2, LERNEOCERADÆ, containing two genera	*Lerneocera.* *Lernea.*

In M. Latreille's second method, the *Entomostraca* were treated as a sub-class, with the following characters :—Mandibles naked or none; mouth formed of two rows of pieces; antennæ and feet of a branchial form; tarsi without a horny nail at the end; shell clypeaceous or shield-like, univalve or bivalve, or with annular horny or membranous segments of the body; eyes sessile, often united so as to form one.

1st Section. (Operculés, shell univalve or bivalve.)

*

Shell Univalve. (Clypeacés.)
1st Order, Xyphosures. (Ex. *Limulus.*)
2nd Order, Pneumonures. (Ex. *Ozolus.*)
3rd Order, Phyllopodes. (Ex. *Apus.*)

**

Shell Bivalve. (Ostrachodes.)
4th Order, Ostrachodes. (Ex. *Cypris.*)

2nd Section. (Nues, body annulated throughout its length.)
5th Order, Pseudopodes. (Ex. *Cyclops.*)
6th Order, Cephalotes. (Ex. *Polyphemus.*)

In the last edition of Cuvier's 'Règne Animal,' M. Latreille divides the *Entomostraca* into two orders :—

I. BRANCHIOPODA.

II. PŒCILOPODA.

The PŒCILOPODA he divides into two families :—

1st. *Xyphosura.*

This family consists but of one genus, namely, *Limulus.*

2nd. *Siphonostoma.*

This family he separates into two tribes :—

1. *Caligides.*

This tribe contains the genera *Argulus*, *Caligus*, and its sub-genera *Pandarus*, *Dinemoura*, &c., and *Cecrops.*

2. *Lernæiformes.*

This tribe consists of *Dichelestium* and *Nicothoë.*

M. Milne-Edwards remarks, that at the first glance the branchial feet of *Apus* and of many other *Entomostraca* would appear to have hardly anything in common with the ambulatory feet or buccal members of the Decapods; but, nevertheless, the same parts are found among the former. In fact, he observes, in the great foliaceous laminæ or blades, the structure of which seems as complicated as it is anomalous, the analogues of the flagrum (fouet), palp, and stem (tige) are easily traced. The first of these appendages constitutes the flattened vesicle which occupies the basilary and external part of the foot: its form is the same as among the Stomapods, and its structure further confirms the approximation.

The last-named author proposes the following method, differing from that of Latreille not only in the number of the orders under which the different *Crustacea* are arranged, but also in the limits assigned to many of these divisions :—

A. Mouth deprived of special organs of mastication.

Orders.
Xyphosures.
Siphonostomes.

B. Mouth armed with special organs of mastication, namely, with one pair of mandibles, and with one or more pairs of jaws.

Orders.

Ostrapodes.	Isopodes.
Cladoceres.	Amphipodes.
Phyllopodes.	Stomapodes.
Copépodes.	Decapodes.
Læmipodes.	

M. Milne-Edwards further states that Latreille, a little before his death, was again occupied with the subject, and introduced into his method many modifications, which made it approach nearly to that proposed by M. Milne-Edwards. The latter says that Latreille in fact admitted into the class *Crustacea* 12 orders, namely, the Decapods, the Stomapods, the Læmipods, the Amphipods, the Isopods, the Dicladopods, the Lophyropes, the Ostrapods, the Xyphosures, and the Siphonostomes; and that the Dicladopods very nearly correspond to the Copepods of M. Milne-Edwards. The last-named author, when speaking of Latreille's classification in the first edition of the 'Règne Animal,' speaks of Latreille's not attaching to the distinction of *Malacostraca* and *Entomostraca* an importance which those divisions do not deserve; but M. Milne-Edwards still retains the term *Entomostraca;* for we find in his synoptical table ('Histoire Naturelle des Crustacés—Suites à Buffon'), under the sub-class of Maxillated Crustaceans, the legion of Branchiopods, containing the orders *Ostrapoda* and *Phyllopoda*, and the legion of *Entomostraca*, consisting of the orders *Copepoda* and *Cladocera.*

The reader who wishes to study the classification, economy, and anatomy of the *Entomostraca*, should more particularly consult, besides the works above alluded to, those of Swammerdam, Needham, Leuwenhoek, De Geer, Ramdhor, Schöffer, Straus, Hermann, the younger Fabricius, the Jurines, father and son, Adolphe Brongniart, Slabber, Desmarest, De Blainville, Thompson, and Audouin.

Fossil Entomostraca.

The remains of small *Crustacea* evidently referrible to this family have been found in many strata. Setting aside the *Trilobites*, whose affinities are evidently with the *Entomostraca* [TRILOBITES], and which abounded in the earliest Palæozoic Rocks, species belonging to the group *Ostracoda* have been described as occuring in the older Secondary Rocks. M. Hitsinger has figured and described two species from the Silurian Rocks of Sweden; Count Münster has given short descriptions of eight species from the Bergkalk of Regnitztorae near Hof; Professor M'Coy has figured and described twenty-two species from the Carboniferous Limestone of Ireland; M. de Koninck six species from the Carboniferous System of Belgium, and Mr. Bean one species from the Newcastle Coal-Beds. Species have also been described by Portlock, Horner, Hibbert, and Murchison, making altogether about thirty-seven distinct forms belonging to the Silurian and Carboniferous Rocks. Ten species have been described from the Magnesian Limestone of North Britain, and Mr. Rupert Jones has described twenty-six species from the Chalk. The fossil species mostly belong to the genus *Cythere.* [CYTHERE.] Species have also been found in the Wealden Beds of Great Britain and in the Tertiaries of Europe. The forms of the *Entomostraca* have at present been only partially examined, but the results already obtained lead to the conviction that in all strata there are deposits of these animals which, when properly examined into, will lead to the discovery of many new and instructive forms.

(Jones, *On the Entomostraca of the Cretaceous Formations of England*, and *On Permian Fossils*, in *Palæontographical Society's Works.*)

ENTOPHYTA (from ἔντον and φυτόν), a term applied to plants found living within animal bodies. The term *Epiphyta* has been applied to those forms of plants which live upon the external parts of organised beings whether plants or animals. It is however difficult to draw the line between these two classes, because it frequently happens that a plant whose spores are deposited in the interior of an animal body, in the course of growth find their way to the surface. The term Epiphyte has also been employed to designate those higher forms of plants, more especially the *Orchidaceæ* which are found growing on other plants, so that the term Entophyte is more especially used to designate those cryptogamic plants which grow on the skin or mucous membranes of animals. These will be more particularly referred to here. At the same time it should be observed that a large number of cryptogamic plants are found in the living tissues of other plants, and claim to be regarded as Entophytes in relation to the vegetable kingdom.

The study of *Entophyta* has been invested with considerable interest, since by the aid of the microscope so many of these plants have been detected accompanying various diseased conditions of the animal body. Although they have been perhaps more carefully investigated in the human body, it has been for a long time a familiar fact that many of the lower animals are attacked by these plants in states of disease. Thus the cultivators of the silk-worm have observed the growth of a species of *Botrytis* in the organs of that animal, producing great destruction amongst them, and the occurrence of this fungus is known by the name of Muscardine. [MUSCARDINE.] Caterpillars have been brought to this country from New Zealand, Australia, and China, as curiosities, from the bodies of which a species of *Clavaria* or *Sphæria* of considerable size is found to project. A species of *Polistes*, a kind of wasp, has been observed in the West Indies to be subjected to the attacks of a fungus which appeared on the surface of its body in the form of a growth as large as itself. The common house-fly is often seen in the autumn of the year adhering helplessly to a pane of window-glass from the growth of a fungus on its body, which has not been free from the suspicion of producing even so formidable a disease as cholera. Gold-fish, when kept in confinement, as well as water-salamanders and sticklebacks, have been observed to be covered with a fungus (*Achlya prolifera*) before death.

These facts, and many others, have from time to time attracted attention, which, having been followed up by diligent observations with the microscope, have led to the discovery of a very large class of vegetable bodies taking up their ordinary residence within or upon animal surfaces.

A question has been raised as to whether these plants are the natural products of the bodies on which they are found, as other plants are of the soil in which they grow, or are introduced from some foreign and extraneous source. From the observations that have been made up to the present time, it appears that these plants are truly in their natural positions in the localities in which they are found, and that they only multiply or become sources of disease when the bodies on which they grow get into a disordered state. In the same manner the ova of animalcules seem constantly present in the air and water, only awaiting the proper combination of circumstances to be developed in prodigious numbers. The circumstances which predispose to the growth of these Entophytes upon the body, are not better known than those which predispose the body to receive certain contagions. A failure of the ordinary vital powers to carry on the healthy processes of life seem ordinarily to be the inviting cause of such a development of these plants as would constitute a disease.

All the observations that have been made on this important subject have been brought together by M. Robin in his work on the 'Natural History of the Parasitic Vegetables which Grow on Man and on Living Animals' (Paris, 1853). The following is a classification of these plants:—

I. ALGÆ.

Class *Isocarpeæ*.
 Sub-Class I. *Diatomeæ*.
  Genus *Psorospermia*, 11 species.
 Sub-Class II. *Malacophyceæ*.
  Tribe *Gymnospermeæ*.
   Order I. *Eremospermeæ*.
    Sub-Order I. *Mycophyceæ*.
     Family *Cryptococceæ*.
      Genus *Cryptococcus*, 2 species.
  Tribe *Palmelleæ*.
      Genus *Merismopædia ventriculi*. [SARCINA.]
     Family *Leptothriceæ*.
      Genus *Leptothrix*, 2 species.
      Genus *Cladophytum comatum*.
      Genus *Arthromitus*, 2 species.
  Tribe *Leptomiteæ*.
      Genus *Leptomitus*, 6 species.
      Genus *Moulinica*, 3 species.
  Tribe *Laprolegnieæ*.
      Genus *Saprolegnia ferax*.
      Genus *Enterobryus*, 4 species.
      Genus *Eccrina*, 2 species.
    Sub-Order III. *Tiloblasteæ*.
     Family *Oscillarieæ*.
      Genus *Oscillaria*.
      Genus *Zygnæma cruciatum*.
   Order II. *Cryptospermeæ*.
     Family *Chætophoreæ*.
      Genus *Chætophora meteorica*.

II. FUNGI.

Division I. *Arthrosporei*.
  Tribe *Torulacei*.
      Genus *Trichophyton*, 3 species.
      Genus *Microsporon*, 3 species.
      Genus *Sporendonema musca*.
  Tribe *Oidiei*.
      Genus *Achorion Schœnleinii*.
      Genus *Oidium*, 3 species.
  Tribe *Aspergillei*.
      Genus *Aspergillus*, 8 species.
Division II. *Trichosporei*.
  Tribe *Oxycladei*.
      Genus *Dactylium oogenum*.
      Genus *Botrytis Bassiana*.
  Tribe *Sporotrichei*.
      Genus *Sporotrichum*.
  Tribe *Isariei*.
      Genus *Isaria*, 12 species.
Division III. *Cystoporei*.
  Tribe *Columellati*.
   Section *Ascophorei*.
      Genus *Mucor Mucedo*.
Division IV. *Chirosporei*.
  Tribe *Coniopsidei*.
   Section *Phragmidiei*.
      Genus *Puccinia favi*.
 Sub-Division *Endoclivei*.
   Section *Spheronomei*.
      Genus *Laboulbenia*, 2 species.
  Tribe *Sarcopsidei*.
      Genus *Stilbum Buquetii*.
Division V. *Thecasporei*.
  Tribe *Sphæriacei*.
      Genus *Sphæria*, 8 species.
      Genus *Kentrosporium*, 2 species.

The following is a list of the distribution of the species of the above genera in the various localities of the animal body.

I. Man and the *Mammalia*.
 A. The Skin.
  Trichophyton tonsurans. Malmsten. (On Hairs.)
  T. sporuloides. Ch. Robin.
  T. ulcerum. Ch. Robin. (On Ulcerated Skin.)
  Microsporon Audouini. Gruby. (Hair Follicles.)
  M. mentagrophytes. Ch. Robin. (Roots of the Hair.)
  M. furfur. Ch. Robin. (Skin.)
  Mucor mucedo. Linnæus.
  Achorion Schœnleinii. Remak. (The Hair and the Hair Follicles.)
  Aspergilli species. Pacini et Meyer. (Auditory Passage.)
  Puccinia favi. Ardsten.
 B. On the Mucous Membrane.
  Cryptococcus cerevisiæ. Kützing. (Intestines.)
  C. guttulatus. Ch. Robin. (Rabbit.)
  Merismopædia ventriculi. Ch. Robin. [SARCINA.]
  Leptothrix buccalis. Ch. Robin. [SARCINA.]
  Oscillaire (?) of the Intestines. Farre.
  Leptomitus urophilus. Mont. (Bladder.)
  Leptomitus of Hannover. Ch. Robin. (Pharynx and Œsophagus.)
  Leptomitus of the Epidermis.
  Leptomitus of the Uterus.
  Leptomitus of Uterine Mucus.
  Leptomitus of the Eye.
  Oidium albicans. Ch. Robin. (In Thrush.)
  Fungus of the Lungs. Bennett. [OIDIUM.]
  Fungus of the Nasal Mucus.
II. Birds.
 A. Of the Respiratory Organs.
  Aspergillus candidus. Michele. (The Air-Cells and the Lungs.)
  A. glaucus. Fries.
  A. nigrescens. Ch. Robin. [MOULD.]
  A. Strix nyctea. J. Müller and Retzius.
  Mouldiness of the Lungs of the Jackdaw. Meyer.
 B. The Eggs.
  Dactylium oogenum. Montague.
  Sporotrichum (*Nematogonum*) *brunneum*. Schenk.
III. Reptiles.
 A. The Eggs.
IV. Batrachians.
 A. The Skin. *Saprolegnia ferax*. Kützing (*Achlya*, Nees von Esenbeck). [ACHLYA.]
V. Fishes.
 A. The Skin.
  Zygnema cruciatum. Agardh.
  Chætophora (*Tremella*) *meteorica*. Ehrenberg.
  Saprolegnia ferax. Kützing.
  Trichotraunia dermale. E. Germain of St. Pierre.
  Confervæ of Gold-Fish. Bennett.

Algæ of the Stickleback. Manicus.

B. The Gills and the Cellular Tissue.

Psorospermia of the Pike. J. Müller.

P. of the *Synodontis Schal.* J. Müller.

P. of the Sandre. (*Lucioperca sandra*). J. Müller.

P. of the Roach. (*Cyprinus rutilus*). J. Müller.

P. of the *Labeo niloticus.* J. Müller.

P. of the *Pimelodus Blochii.* J. Müller.

P. of the *Pimelodus Sebæ*, and of *Platystoma fasciatum.* J. Müller.

P. of the *Catastomus tuberculatus.* J. Müller.

P. of the *Gadus callarias.* J. Müller.

P. of the *Acerina vulgaris* of Grenville. Creplin.

P. of the *Sciæna umbra.* Ch. Robin.

C. The Eggs. *Saprolegnia ferax.* Kützing.

VI. Insects.

A. On the Elytra, and on the Articulations.

Botrytis Bassiana. Balsamo. Montagne.

Laboulbenia Rougelii. Ch. Robin. Montagne.

L. Guerinii. Ch. Robin.

Stilbum Buquetii. J. Müller and Ch. Robin.

B. On the Caterpillars and Chrysalises in the Tissues.

Botrytis Bassiana. Balsamo. Montagne.

Genus *Sphæria.* Haller. [SPHÆRIA.]

Section *Cordyceps.* Fries.

Sphæria militaris. Ehrenberg.

S. sphærocephala. Klein.

S. entomorhiza. Dickson.

S. sobolifera. Hill.

S. Sinensis. Berkeley.

S. Robertsii. Hooker.

S. Taylori. Berkeley.

S. Gunnii. Berkeley.

Kentrosporium microcephalum. Wallroth.

K. mitratum. Wallroth.

Isaria eleuteratorum. Nees. [ISARIA.]

I. floccosa. Fries.

I. strigosa. Fries.

I. arachnophila. Dittmar.

I. leprosa. Fries.

I. Tartarica. Wallroth.

I. crassa. Persoon.

I. sphecophila. Dittmar.

I. exotcla. Fries.

I. aranearum. Schweinitz.

I. sphyngum. Schweinitz.

I. gigantea. Montagne.

C. In the Intestines.

Mouliniea chrysomelæ. Ch. Robin.

M. cetoniæ. Ch. Robin.

M. gyrini. Ch. Robin.

Leptothrix insectorum. Ch. Robin.

Genus *Eccrina.* Leidy.

E. longa. Leidy.

E. moniliformia.

Cladophytum comatum. Leidy.

Anthromitus cristatus. Leidy.

A. nitidus. Leidy.

VII. The Myriapoda.

A. In the Intestines.

Enterobryus elegans. Leidy.

E. spiralis. Leidy.

E. attenuatus. Leidy.

E. Juli-terrestris. Ch. Robin.

VIII. The Mollusca.

A. On the Vesicle of Slugs. (Algue indéterminée, Lebert.)

B. The Eggs. *Saprolegnia ferax.* Kützing.

The most interesting of these species are undoubtedly those which attack man or the animals which he domesticates and employs. With the exception of the *Botrytis* of the silk-worm, the latter have not been much investigated. Those which attack man, and accompany diseased conditions of his body are better known. They may be divided into those which are found on the skin, and those which are attached to or found in the secretions of the mucous membrane.

I. *Entophyta* of the Skin.—Ten species have been noted in this locality. We shall enumerate them in the order in which they are given by M. Robin.

1. *Trichophyton tonsurans* (Malmsten); *Trichomyces tonsurans; Mycoderma* of the *Plica Polonica;* fungus of the hairs in *Herpes tonsurans*, fungus of *Porrigo scutulata, Achorion Lebertii;* fungus of the *Teigne tondante*, Bazin; *Rhizophyte*, Gruby. This fungus was discovered and described in 1844 by Gruby in the disease called by the brothers Mahon *Teigne tondante*, by Cazenave *Herpes tonsurans*, by Erasmus Wilson *Trichosis furfuracea* (one of the diseases called Ringworm and *Porrigo scutulata* in this country). It exists also, as pointed out by Gunsberg, in the *Plica Polonica*, although the two plants were formerly described as different. The *Trichophyton* is formed by oval transparent spores; which give rise to articulated filaments. Its anatomical seat is in the interior of the roots of the hairs. The hairs and fungi simultaneously increase. The former seem larger than usual, are paler in colour, lose their elasticity, soften, and break off when they have risen some one or two lines above the surface of the scalp. In the short cylinder then left the fungus grows still more rapidly, so that the normal structure of the small stump of hair soon becomes indistinguishable. Sometimes the hair breaks off before emerging from the skin, and the fungus, epidermis, and sebaceous matter, fill the ends of the piliferous conduits, and form the little prominencies which can be seen by the naked eye in this disease, and give the skin a rough anserine appearance. The sporules and mycelium of the plants can sometimes be seen, in the form of a white powder, on the roots of the broken hairs. Sometimes the cutis becomes congested and thickened, and then the plant is mixed up with scales of epidermis, with fatty and albumenoid granules, with pus, &c., and crusts are formed of greater or less thickness in which the growth of the fungus can go on. Messrs. Robin and Bazin adopt unreservedly the opinion that the *Trichophyton* is the cause of the disease known under the various names above given, and each has given examples of the contagion of the disease by the transmission of the spores. Bazin has made the very important observation that the same disease will attack horses, and can be communicated from them to men. Both Robin and Bazin however admit that there is some condition of the hairs (dependent no doubt on constitutional causes) which is essential for the growth of the plant, as sometimes the disease disappears, that is, the fungus dies, without treatment. With respect to the name of the most common disease in which the *Trichophyton tonsurans* appears, the term used by Cazenave (*Herpes tondens*) is extremely unfortunate. No doubt vesicles are sometimes seen, and sometimes the cryptogamic disease succeeds to true *Herpes circinata* of the scalp, but in many cases there are no vesicles at all throughout the whole course of the disease. The term used in this country *Porrigo scutulata* is inconvenient as it is applied with greater justice to *Favus.* The old term of *Tinea* is after all by far the best, and the specific affix *tondens* expresses well one feature of the disease, the baldness arising from the brittleness of the hairs.

2. *Trichophyton* (?) *sporuloides* (Robin). (*Mycoderme* of the *Plica Polonica*). In addition to the former species, Walther describes in the *Plica Polonica* oval or circular flattened sporules, which have been too little studied at present to permit their exact characters to be stated.

3. *Trichophyton* (?) *ulcerum* (Robin). Lebert has described a fungus in the crusts covering an atonic ulcer of the leg.

4. *Microsporon Audouini* (Gruby). This plant has been studied by Gruby, and its existence, though denied by Cazenave, has been confirmed by Robin. It is present in the disease commonly called after Willan, *Porrigo decalvans* or *Alopecia circumscripta*, or by Bazin, *Tinea achromatosa.* It differs from the *Trichophyton* of *Tinea tondens*, by its numerous waved filaments, and by the extremely small size of its sporules. It is not found, like the *Trichophyton*, in the interior of the root, but forms round each hair a little tube; the hair then becomes opaque, softens, and breaks off. The Alopecia is rapid, with or without vitiligo of the skin. The dermis is not congested, and the epidermis is thin and smooth. There is an affection which should probably be distinguished from the *Porrigo decalvans*, or *Alopecia circumscripta*, and which is characterised by a rapid disappearance of pigment from both skin and hair, with or without Alopecia. M. Bazin includes it in his *Tinea achromatosa*, but does not mention the fact that Alopecia is not constant. He states that a parasitic plant is present, but does not describe it. There must however be something more than a fungus to cause the total disappearance of pigment from a considerable portion of dermis. Besides, when the hairs return they are at first white, and only gradually regain colour; but if the vitiligo were owing to a plant it is probable they would not grow at all. The disease appears to be allied to those obscure pigmentary changes which have a much deeper seat than the surface of the body.

5. *Microsporon mentagrophyta* (Robin), (*Mentagrophyte*, Gruby). This is a plant resembling the preceding, but possessing larger spores and filaments. It was discovered by Gruby in a case of mentagra, and has been since described by Bazin. Its seat differs from that of the preceding, and from that of the *Trichophyton.* It is between the bulb of the hair and the follicle in which the bulb is seated, and never extends beyond the surface of the skin.

6. *Microsporon furfur* (Robin). In 1846 Eichstedt discovered a cryptogamic plant in the disease called by Willan *Pityriasis versicolor*, and more lately *Chloasma.* Soon afterwards Sluyter described the same fungus, and lately Sprengler has described and figured it. It forms with the epidermic scales the yellowish-brown scurf seen in *Pityriasis.*

7. *Achorion Schœnleinii* (Remak), (*Oidium Schœnleinii; Mycoderma* of *Tinea favosa; Porrigophyte* (Gruby); Fungus of *Favus.* Schœnlein was the first to suggest that the honeycomb, or yellow favous crusts in the so-called *Porrigo lupinosa* (Willan) and *P. scutulata* were constituted by a vegetable growth. This has been repeatedly confirmed, and many excellent descriptions have been given of the disease now called indifferently *Favus, Tinea favosa*, or *Porrigo scutulata.*

M. Robin believes he has discovered that the primary seat of the

Achorion is in the depth of the hair follicle, against the hair, and, as well as we can understand the description, outside the layer of epithelium which covers the root of the hair, and which forms the 'inner root-sheath' of Kölliker. In this observation however he has been anticipated by Wedl, who has pointed out that by using a concentrated solution of liquor potassæ to make the parts transparent, the fungus is found in the follicle round the hair at the place where it passes through the epidermis. In addition to this, the plant is found in depressions on the surface of the skin, forming the yellow honeycomb-like masses which give the specific name *Favus* to the disease, and which from their frequent buckler-like shape suggested the term *scutulata*. The development of the *Achorion* in this situation is described by Robin after Remak and Lebert. A cuticular elevation is seen, beneath which is a small favus. When the cuticle is raised, a drop of pus sometimes issues: hence the error of those who have considered this disease always pustular. Generally however there is no pus or liquid of any kind. The plant grows, and the cuticle over it (supposing it has not been forcibly detached) finally separates, leaving the favus exposed to the air.

M. Bazin describes the *Favus* under three heads, which are fundamentally identical, and different only in respect of form:—

1. *Favus urceolaria dissemina*: this corresponds to the *Porrigo favosa*, *Favus dispersus*, and *Teigne alveolaire* of other authors.
2. *F. scutiformis*: this is the *Porrigo scutulata*, or *F. confertus*.
3. *F. squamosa*, a form usually called *scutulata*, but distinguished chiefly by the irregular distribution of the achorion, and by the furrowed masses formed by the fungus, the hairs, epidermis, and exudation.

8. *Puccinia Favi.* The achorion constitutes, with epithelium and a little exudation, the mass of the *Favus*; but it has been lately (1850) observed by Ardsten, of Christiania, that a different fungus, a species of *Puccinia*, is occasionally also present. Robin considers it to be only an epiphenomenon, and that it is certainly not present in all cases. The *Puccinia* is easily recognized. It has one extremity (the body) rounded, and composed of two cells of unequal size, a superior and an inferior. The other extremity is prolonged into a pointed stem or trunk.

There are still three other plants found upon the skin which need merely be enumerated.

9. *Mucor.* In senile gangrene, an ill-described fungus, supposed to be the *Mucor mucedo* of Linnæus, has been seen on the sloughing mass.

10. *Aspergillus.* In the wax in the external meatus of the ear, Mayer many years ago described a fungus, and Paccini has lately made a similar observation—*Leptomitus* (?) of the epidermis. An *Alga* has been seen by M. Gubler in the epidermis of an arm which was irrigated for a long time to keep down inflammation after a gunshot wound. No one else has noticed it. Not only Messrs. Robin and Bazin, but Simon and others of the best dermatologists of Europe, have adopted the opinion that the plants are the actual causes of the diseases in which they are found. The contrary opinion is generally held in this country, on the grounds that fungi are generally the proofs and consequences of decay, but not its causes; that in the various forms of *Tinea* a special condition of the skin and hairs appears necessary for the growth of the plant; and that in *Tinea favosa* (*Favus*) in particular, a marked feature of the disease occasionally is an hyper-secretion of epithelium and exudation, owing to an hyperæmic cutis, before any trace of fungus can be found.

Nevertheless, these arguments, strong as they are, seem to be overborne by the two grand facts that *Tinea tondens* and *Tinea favosa* can be communicated by transfer of the plant, and that the disease can be cured with the greatest readiness by the chemical agents which are most destructive to vegetable life. That a special nidus is necessary may very well be admitted by the partisans of this view, since even in the case of epidemic agents a predisposition is necessary; yet no one dreams of confounding the co-operating cause with the special and peculiar poison.

It may be desirable to recapitulate the diseases of the skin in which parasitic plants are found:—

1. *Tinea tondens*, in which the *Trichophyton tonsurans* is present.
2. *Tinea favosa*, in which are present the *Achorion Schœnleinii*, and the *Puccinia Favi* in some cases.
3. *Mentaga*, or *Tinea mentagra*, which exhibits the *Microsporon mentagrophyta*.
4. *Pityriasis versicolor* (*Chloasma*), in which the *Microsporon furfur* occurs.
5. *Porrigo decalvans* (*Tinea achromatosa*) in which the *Microsporon Audouini* is found.
6. *Plica Polonica*, in which the *Trichophyton tonsurans* and *Trichophyton sporuloides* are present.

II. *Entophyta* on the Mucous Membrane.—The plants forming on mucous membranes, or in the contents of cavities lined by mucous membrane, are of less interest than those which grow on the skin, as in most cases they are decidedly only secondary. We shall merely enumerate them:—

1. *Cryptococcus Cerevisiæ*, Kützing (*Torula Cerevisiæ*), the Yeast-Plant in the bladder, stomach, intestines, &c.
2. *Merismopœdia ventriculi*, Robin (*Sarcina*), in the stomach, intestines, &c.
3. *Leptothrix buccalis*, Robin (*Alga*), of the mouth.
4. *Oscillaria* of the intestines. (Farre.)
5. *Leptomitus urophilus*, Montague; an *Alga* described as forming in the urine. It has as yet been scarcely studied.
6. *Leptomitus* (?), Hannover, Robin; *Alga* found by Hannover in the pharynx and œsophagus.
7. *Leptomitus* of the uterus.
8. *Leptomitus* of the uterine mucous.
9. *Leptomitus* of the eye.
10. *Oidium albicans*, Robin (*Cryptogamiæ*), of diptheritis and aptha; Aptophyte. (Gruby.)
11. Fungus of the lungs. (Bennett.)
12. Fungus in the discharge of glanders.

To this list from M. Robin may be added the so-called Cholera Fungus of Brittan and Budd. It should however be added that no confirmation of the view originally taken by the discoverers, that the fungus discovered in the dejections of those affected with cholera was the cause of the disease, has been afforded. The only explanation that can be given of the occasional occurrence of the spores of fungi or spore-like bodies on the mucous membrane of the stomach and intestines, is their introduction with the food. It has been stated above that the spores of certain species of fungi are found naturally on grains of wheat, and only await favourable conditions for development. Such fungi may be constantly introduced into the stomach with the flour of wheat in the form of bread or other kinds of food.

"In the study of the vegetable parasites of animals, particularly those of the intestinal canals, it is necessary to be careful not to confound the tissues of certain well-known cryptogamic plants, which may serve as food or adhere to the ordinary food of such animals, with true *Entophyta*. Thus, fragments of fungi, confervæ, lichens, and the spores of these, used as food, or adhering as foreign matter to food of an ordinary kind, are liable within the intestine to be mistaken for parasites.

"In mid-winter I found beneath an old fence-rail an individual of *Achela nigra*, or large black cricket, within the proventriculus of which were large quantities of what I supposed at the time to be a free floating Entophyte, resembling in general appearance the ordinary Yeast Fungus, *Torula*, but which I now suspect to be an ergot upon which the animal had fed. The plant consisted of oblong or oval vesicular bodies, apparently thickened at the poles, and filled with a colourless liquid; but this appearance more probably arose from the cells being distended with a single large, transparent, colourless, amorphous globule, which pressed a small existing amount of protoplasma to each end of the cavity. The cells were single, or in rows, to eighteen in number. Frequently a single cell of comparatively large size had an attached pair of cells, or rows of cells, at one or both ends. Occasionally they are met with containing one or two small round hyaline amorphous nuclei. The isolated cellules, measured from the $\frac{1}{2500}$th to the $\frac{1}{1800}$th of an inch in length by the $\frac{1}{8000}$th to the $\frac{1}{5000}$th of an inch in breadth. The rows measured up to the $\frac{1}{300}$th of an inch in length." (Leidy.)

(Leidy, *A Flora and Fauna within Animals*; Robin, *Histoire Naturelle des Végétaux Parasites*; Bazin, *Recherches sur la Nature des Teignes, &c.*; Parkes, *Epiphytes and Entophytes*; *Brit. and For. Medico-Chirurgical Review*, 1853; *Journal of Microscopical Science*, vol. ii.)

ENTOZO'A, from ἐντὸς, within, and ζῷον, an animal. Under this name are designated the different living beings which are produced and developed within other living beings. It comprehends a series of animals differing greatly from one another in form and organisation, and having but one character in common, which is, that they are all parasitic, or have their exclusive habitation in, and live at the expense of, the bodies of other animals. They can scarcely be said to form a distinct class in the animal kingdom, some of the species being closely resembled, both in external appearances and internal structure, by individuals placed in other classes, and only differing from them in the localities where they are found; thus, the zoosperms, or seminal animalcules, which are enumerated by some zoologists with the *Entozoa*, closely resemble the true *Cercariæ* of vegetable infusions.

Entozoa are found in most animals. They have been discovered in all the *Mammalia*, from man down to the *Cetacea*; they also occur in the other classes of the *Vertebrata*; indeed, it seems that a greater number reside in birds, reptiles, and fishes, than in mammals. The *Invertebrata* have also their peculiar parasites; and they have been ascertained to exist in all the Insect tribes, and in beings still lower in the scale. The best known species are those which inhabit the intestines of the human subject, and vulgarly go by the denomination of Worms, which term was probably derived from the resemblance which the *Ascaris lumbricoides* bears to the common earth-worm, as this species is most frequently met with, and was the first described of the human *Entozoa*, being mentioned by Hippocrates, who called it the ἕλμινς στρογγύλος, or round worm. The origin of *Entozoa* is involved in some obscurity, as well as the circumstances under which they are developed.

"Within living beings," says Dr. Leidy, "that is, within their cavities or the parenchyma of the organs, of course all the indisputable conditions of life exist, and consequently we cannot wonder at their being infested with other living beings adapted to their parasitic position. Nevertheless, although the conditions of life are necessarily ever present in living beings, yet these frequently do not contain parasites. There are many circumstances, besides those essential to life in general, which influence the existence or non-existence of such forms. One of the most important of these circumstances is the convenience or ease of access or of entrance to the living body infested. Within the living closed organic cell parasites very rarely if ever exist, because it is liquid matter only which can endosmose through cell membrane, and therefore solid germs cannot enter, and hence the unfrequency of true *Entozoa* in vegetables. *Entozoa* may and do penetrate through living tissues, but it is entirely by the mechanical process of boring.

"The intestinal canal of animals is most frequently infested by entoparasites on account of the ease with which their germs enter with the food.

"Aquatic animals are more troubled by *Entozoa* than those which are terrestrial, because the water affords a better medium of access than the air.

"Terrestrial animals, on the other hand, are more infested by ectoparasites because their covering of hair, wool, and feathers, is more favourable to their protection and reproduction. A low degree of organic activity and slowly digestible food favour the development of entoparasites, and hence they are more frequent in the relatively sluggish *Herbivora* than in the *Carnivora*. Comparatively indigestible food, and such as contains but a small proportion of nutritive matter, from its long retention in the alimentary canal, favours the development of entozoic and entophytic germs more than that in which the contrary conditions prevail. Animals subsisting upon endosmosed pieces of the tissues of other animals and of plants are rarely infested by parasites, as in the case of the hemipterous insects, aphides, &c., because such food is necessarily free from parasites or their germs. *Entozoa* themselves, on this account, are not infested.

"On the other hand, if the liquid food be open to the air, parasitic germs may be readily introduced into the animal, as in the case of the common house-fly, which often contains myriads of a species of *Bodo*. Food swallowed in large morsels favours the introduction of attached parasites; hence these are frequently found in reptiles, and even in birds, which are among the *Vertebrata* of the highest organic activity.

"Animals of feeble organic activity, using solid food, which is very slowly digested and contains little nutriment, are rarely free from parasites. This is the case with the coleopterous insect *Papalus* and myriapod *Julus*. Cooking food is of advantage in destroying the germs of parasites, and hence man, notwithstanding his liability to the latter, is less infested than most other *Mammalia*. Did instinct originally lead him to cook his food to avoid the introduction of parasites?

"*Entozoa* are more abundant than *Entophyta* [ENTOPHYTA], because the power of voluntary movement favours them in their transmigrations, and renders them less liable to expulsion from the intestinal canal."

Although it is now a general opinion that the *Entozoa* are introduced from without, it is very certain that with some it cannot be in their adult form. From some recent researches it appears that, like many of the Radiate Animals, the *Entozoa* assume various forms after escaping the egg before they attain their final condition. Steenstrup, in his 'Alternation of Generations,' has shown that *Entozoa* belonging to the Trematode forms, pass through various conditions of existence. Thus he has traced the species of *Distoma* in the higher animals to the various forms of *Cercariæ*. Mr. Busk has also pointed out ('Transactions of Microscopical Society,' vol. ii.) the probability that one of the Nematoid Worms, the *Filaria Medinensis*, the Guinea-Worm, passes through other forms before it penetrates the human body, and assumes its characteristic form in the human skin. With regard to the *Entozoa* of the higher animals, their eggs seem to be produced in that position, but not to be perfected where they have been generated. It has been shown that the ova of the *Bothriocephalus*, an entozoon found in birds, never come to perfection unless the ova are first swallowed by the Stickleback, which being eaten by the bird, the entozoon takes the opportunity of assuming its proper form. The *Gordius*, or Hair-Worm, deposits its eggs in water, but the eggs are not developed in this position; they are first swallowed by insects, and in this position the egg is hatched, producing the *Gordius*, which becomes impregnated, and escapes from the insect into waters where it deposits its eggs. The ova of a species of *Tænia*, Tape-Worm, when swallowed by the rat or mouse, will not produce perfect tape-worms in the inside of these creatures, but if they are eaten by the cat or dog, then the perfect tape-worm is produced. [GENERATION, ALTERNATIONS OF.]

According to the derivation of the word *Entozoa* and the definition which we have given of it, this term should include every living creature found in the body of another (which has not been introduced from without): therefore the small microscopic animalcules detected in the semen of animals, called *Spermatozoa*, come under this head; and in a very able paper on the 'Entozoa' by Professor Owen, we find them placed accordingly in this class, only situated in a separate group, denominated *Protelmintha*, and divided from the animals forming the class *Entozoa* of Rudolphi. These minute beings, which, from their size and organisation, rank with the assemblage of animalcules which are collected under the head *Infusoria* in the 'Règne Animal,' have been detected in the secretion of the testicles of various mammiferous animals arrived at maturity. When a drop of the secretion is expressed from a divided vas deferens shortly after death, and examined with a microscope, after being diluted with water, it is seen to be filled with minute beings resembling tadpoles, and swimming about in various directions, with different degrees of velocity, guided by the inflection of a slender tail. It has been doubted whether these are animated beings at all, or are to be considered as analogous to the moving filaments of the pollen of plants; but leaving this undecided, we may proceed to state that the body is always of a compressed form, which will distinguish these animalcules from the vegetable *Infusoria*, in which the body is always ovoid or rounded. With regard to their organisation, no alimentary canal or gastric cavities have been detected, nor organs of generation; they are said to be fissiparous, the body and tail spontaneously dividing, and forming two independent beings. The shape of these zoosperms differs in different animals, the large end, or body, being bigger in proportion to the tail in some than in others, and their size not being always in relation to that of the animal to which they belong: thus those of the rabbit are nearly as large as those from the bull.

In the present group are also included those minute internal parasites which have been detected in the bodies of many of the *Entozoa* themselves, and which, from their external form, are referrible to the *Infusoria*.

The *Trichina spiralis*, an entozoon found inhabiting the muscles of the human subject, has been placed by Professor Owen, who first described it, with the preceding animalcules; but further observations on its organisation have discovered a complexity of structure which qualifies it to occupy a place in the highest instead of the lowest group into which the present class of animals is divided.

Cuvier divided the true *Entozoa* into the 'cavitaires,' or those which have an abdominal cavity, and a distinct intestinal canal within it, and the 'parenchymateux,' or those in which no intestinal tube is traceable, and which for the most part consist throughout of an homogeneous structure; but this classification is anything but a natural one, as worms the most dissimilar in their general appearance are here promiscuously congregated together. Professor Owen, in the article which we have before alluded to (in the 'Cyclopæd. of Anat.'), has adopted the arrangement of Cuvier, only inventing new Latin names derived from the Greek, instead of the French terms: thus he denominates the 'parenchymateux' Sterelmintha, from *elmins*, 'a worm,' and *stereos*, 'solid;' and the 'cavitaires' Cœlelmintha, from *elmins*, and *cœlos*, 'hollow.' Zeder laid the first foundation of a good classification of these animals, dividing them into five classes, afterwards called families, at Rudolphi's suggestion; and these were again subdivided into genera and species. Rudolphi himself doubted the possibility of ever reducing all the species of *Entozoa* to absolutely natural and well-defined families, but as Zeder's system seemed the most perfect, he has adopted it for his own; and it does not seem that we can do better than follow the arrangement of this great entozoologist in the present article.

According to this classification the *Entozoa* are divided into five orders, or families, the *Nematoidea*, *Acanthocephala*, *Trematoda*, *Cestoidea*, and *Cystica*. The only point in which we shall depart from this arrangement will be, that, instead of commencing with the most perfect, and descending to the most simple, we shall begin with the lowest in the scale of organisation, and ascend to those possessing the most complicated structure, as this is most in accordance with the laws of the animal kingdom.

Order I. *Cystica* (from κύστις, a bladder), Hydatids. The characters are:—Body flattish, or roundish, and terminating posteriorly in a transparent cyst filled with pellucid fluid, which is sometimes common to many individuals; the head is retractile, and provided with pits two to four in number, or four suckers and a circle of hooklets, or with four unarmed or uncinated tentacles. The organs of generation and nutrition are unknown. This is not a very natural family, the species being closely allied to those of the next order in the structure of the heads; and the *Echinococcus*, or Granular Hydatid, though referred to it, is not hollow.

Order II. *Cestoidea* (from κεστὸς, a band; and εἶδος, form), Tape-Worms. Characters:—Body elongated, flattened, soft, continuous, or articulated, furnished with lateral or marginal pores, and erectile papillæ passing through them, supposed to be the male organs of generation. Head generally provided with two or four pits, or suctorial orifices, and sometimes with four retractile, unarmed, or uncinated tentacles; but the head is so dissimilar in different genera, and their shape varies so much, that they do not form a very natural family. There is no trace of intestinal canal; unless the vessels proceeding from the suckers be considered as such. In some species nutrient vessels and ovaries are to be seen. They are all androgynous.

Order III. *Trematoda* (from τρῆμα, a foramen), Fluke-Worms. Characters:—Body soft, rounded, or flattened. Head indistinct, with a suctorial foramen; one or more suctorial pores on the under surface of the body, which furnish the grounds for their subdivision into genera: they have no intestinal canal, and the organs of generatiou of the two sexes co-exist in the same individual. This is a very natural order.

Order IV. *Acanthocephala* (from ἄκανθα, a thorn; and κεφαλή, the head), Hooked-Worms. Characters:—Body elongated, round, sub-elastic; the anterior extremity or head has a retractile proboscis, furnished with hooks or spicula, arranged in rows. They have uo intestinal canal, but distinct genital organs, and a separation of the sexes. This is a very natural group, and includes the most noxious of the internal parasites; there is only one genus, and fortunately no species is known to infect the human body.

Order V. *Nematoidea* (from νῆμα, a thread, and ειδὸς, form), Round-Worms. Characters:—Body cylindrical, elongated, and elastic; structure very complicated, there being a true intestinal canal, terminated by a distinct anus. The mouth, by its varieties, affords generic characters; the sexes are distinct; the females, which are longer than the males, being for the most part oviparous. They constitute a very natnral order.

Having given the above brief view of the orders into which the class *Entozoa* is divided, with the leading or characteristic differences in their form and organisation, we will now enumerate the principal genera contained in each group, and make a few observations on some of the most interesting species. Following the order of classification, we must commence with the most simple group, the *Cystica;* and here the first parasite which attracts our attention is the common Hydatid, which consists of a globular bag, composed of condensed albuminous matter of a laminated texture, and contains a limpid colourless fluid. No head or appendices of any sort being attached to it, it is appropriately denominated an acephalocyst, that is, a headless cyst. This genus was established by Linnæus, who regarded as animals those productions which before his time had been considered simply as cysts. Considerable diversity of opinion still exists as to their natnre, and it is impossible to determine whether an hydatid is an animal or not, till we can agree what is the definition of an animal: if an animal must have sensation and motion, this is not one, as the best observers agree that the acephalocyst is impassive under the application of stimuli of any kind, and manifests no contractile power, either partial or general. If an animal is characterised on the other hand by independent existence merely, the hydatid is one; and as such we shall regard it, for it is certainly an independent organised being, growing by intrinsic power of imbibition, and reproducing its species by gemmation; the young are developed between the layers of the parent cyst, and thrown off internally or externally, according to the species. It is a being certainly far inferior in the scale to the *Cysticercus*, but still not the less an independent creature. Its structure is very similar to that of some of the lowest forms of *Algæ* in the vegetable kingdom, as the *Protococcus nivalis*, or Red Snow, of the arctic regions, which consists of simple and minute vesicles, which propagate their kind by gemmules developed from the external surface of the parent. Acephalocysts have been found in almost every structure and cavity of the human body, but particularly in the liver, uterus, kidneys, and cellular tissue. The species which resides in man is called *A. endogena*, the Pill-Box Hydatid of Hunter, from the gemmules being detached from the internal surface of the cyst; and it is thus distinguished from those of the ox and other ruminating animals, which are exogenous, or have the gemmules excluded from the external surface.

2. The next genus is *Ecchinococcus*, which, as the name implies, is a round body covered with asperities. The *E. hominis*, or Many-Headed Hydatid, of the Germans, occurs in cysts in the liver, spleen, omentum, and mesentery; tho cyst, which is externally yellow and coriaceous, is unprovided with head or mouth, and contains minute bodies, which are described as possessing the armed and suctorious head characteristic of the *Cœnuri* and *Cysticerci*. From observations made on another species, the *E. veterinorum*, found in animals, the particles adhering to the internal surface of the cyst being examined with a microscope, appeared to be minute animalcules, moving about by means of external vibratile cilia, having an orifice at each extremity of the body, and the centre occupied by large globular stomachs. These little animals are the *Echinococcus*. The following account of these bodies is from the abstract of a paper read by Mr. T. H. Huxley before the Zoological Society. After describing the cysts he says:—

"The contents of the large cysts were free *Echinococci* and secondary *Echinococcus* cysts, contained in a clear fluid. The former were alive, and exhibited distinct contractile motions. Attention was drawn to two important points in their structure; firstly, that the well-known oval corpuscles were not calcareous, inasmuch as they were rapidly dissolved by acetic acid without effervescence, and were considerably acted upon by ammonia. The author supposed that they were albuminous, and that both in these and the *Tæniæ* the conversion into calcareous substances is an effect of degradation; and he pointed out their relations with the solid bodies in the integument of the *Turbellaria*, and with the so-called thread-cells of these and the *Polypes;* secondly, that the peculiar wavy cilia characteristic of a water vascular system could be seen in motion in the living *Echinococci*. The cilia were described by Lebert in 1843, but tho discovery seems to have been forgotten. It is however a point of great importance now that the existence of similar cilia in a definite water vascular system has been demonstrated in the other Cestoid Worms. The proper wall of the cyst (as distinguished from the laminated capsule) was traversed by a network of anastomosing vessels, to the points of union of which the fixed *Echinococci* were attached, the cavity of the pedicle of the latter appearing to be continuous with that of the vessels. It is in the cavity of the pedicle that Virchow observed cilia. The secondary cysts varied in size from 1-100th to 1-30th of an inch. The contained *Echinococci* were always of about the same size, and all the smaller secondary cysts possessed from one to four *Echinococcus* heads attached to their outer surface. The wall of the secondary cysts contains vessels like those of the primary one. In the larger cysts the external heads were found gradually disappearing until they were quite smooth externally. When the secondary cysts were burst, their membrane continued to connect the heads and formed the pedicle described by various authors. The formation of secondary cysts takes place thus:—*Echinococcus* heads are formed over the whole inner surface of the cyst; this then becomes raised up at one spot by the development of *Echinococcus* heads outside it also, and gradually projecting inwards, and acquiring a narrower and narrower pedicle it eventually falls into the cavity of the cyst as a free secondary cyst. The external heads of the secondary cyst (internal of the primary cyst) then gradually disappear, the internal ones (external of the primary cyst) remaining entire and in a normal state. The process is not essentially different from the ordinary germination of a *Tænia*, or *Cysticercus*. The author then endeavoured to show that the *Echinococcus* is nothing but the 'Scolex-form'—to use Van Beneden's term—of a *Tænia* retracted within itself, then greatly dilated, and developing *Echinococcus* heads from its inner and outer surfaces, which are however, like those of a serous sac, in reality both outer. It is the extreme result of modifications similar to those already undergone by the Tænioid type in *Cœnurus* and *Cysticercus*. The conclusion thus drawn on anatomical grounds is strikingly confirmed by the result of the recent experiments of Von Siebold, who fed young puppies on milk containing *Echinococci*, and after a short time discovered *Tænia* in their intestines."

3. *Anthocephalus* is the next genus.—It occurs in fish, in the liver, mesentery, and peritoneum, and within hydatids in the viscera. Each animal exists solitarily in a double bladder, of which the outer layer is hard and elastic, the iuner more thin and delicate. The body is long, flat, terminated behind by a caudal vesicle, and in front by a head with two or four fossæ, and four probosces furnished with spicular processes.

4. *Cœnurus.*—This has the terminal cyst common to many bodies and heads; the former are elongated, flattish, and wrinkled; the latter are furnished with a rostrum, on which there are hooks and suckers adhering in greater or less number to the surface of a bladder filled with fluid. The best known species is the *C. cerebralis*, commonly developed in the brain of sheep, and giving rise to the disease called the Staggers.

5. *Cysticercus.*—Here there is a dilated cyst forming the termination of a single entozoon: the head has four suckers, and a rostrum furnished with recurved processes or hooks. Of this genus one species is known to infest the human subject, the *C. cellulosæ*. It is developed in the interfascicular cellular tissue of the muscles, aud is invariably surrounded by an adventitious capsule of condensed surrounding substance. This entozoon occurs much more rarely in this country than on the Continent. It is not confined to the muscular structures, for several individuals have been detected in the anterior chamber of the eye, where they may occasion so much irritation and inflammation of the organ as to require extraction, which occurred some years ago in a case in the Glasgow Ophthalmic Infirmary. These parasites also occur in quadrupeds, particularly the hog, giving rise to that state of the muscles which is called Measly Pork.

Of the Cestoid order of *Entozoa* Rudolphi has described 8 genera, two only of which contain each a single species that infest the human body:—

1. *Bothriocephalus*, the species of which occur frequently in fishes aud birds, in the branchiæ, œsophagus, pyloric appendices, intestines, and abdominal cavity. The one which affects the human subject, *B. latus*, or *Tænia lata*, rarely falls under the observation of the English entozoologist, but is common in the intestines of man in Switzerland, Russia, parts of France, &c. It may be distinguished from the *Tænia solium* by the form of the segments, which are broader than they are long, and by the position of the genital pores, which are on the under surfaco of the body, instead of at the sides; the head is also very different, for instead of having four round oscula, characteristic of the true *Tæniæ*, there are two lateral longitudinal fossæ or bothria.

2. *Tænia.*—This genus has the body flat, long, articulated, with four suckers on the head. It occurs in the intestines, biliary ducts, gall-bladder, and liver of vertebrate animals. The *T. solium*, commou Tape-Worm, inhabits the humau intestines, but not with equal frequency in all countries, though its distributiou seems to be much more extensive than that of the *Bothriocephalus latus*. It occurs in England, Holland, Germany, Swedeu, Italy, Greece, and most countries in Europe, and also in Egypt and the East; and in all these situations the other genus is comparatively rare.

Tho delicacy of their structure, and their so seldom being obtained entire, has thrown great obstacles in the way of their investigation. The head was for a long while unknown, and it was disputed whether nourishment was taken in by the lateral pores of the several joints or by the mouth alone. Rudolphi says the latter, and it seems now pretty clearly determined that the former are mere outlets of the generative organs. The length to which the *T. solium* is capable of attaining is very considerable, but quite indefinite. Those passed now-a-days seldom exceed twenty feet, but in former times we read of much more gigantic specimens; but whatever may be thought of some of the accounts which are quite improbable, it indubitably has occasionally attained a very great length, having been found extending from the pylorus to within a few inches of the anus, and then by no means fully stretched out. Such cases are however very rare.

The determination of the species in this genus is very difficult: they may be divided for greater convenience into three sections:—The first are without a proboscis, the *Tæniæ inermes;* the second have one, but unarmed, *T. rostellatæ;* the third are furnished with an uncinated proboscis, *T. armatæ.*

3. *Caryophyllæus* has the body flat, continuous; the head dilated, and divided into flattish processes; it is furnished with an upper and under lip. The species of this genus occur in the intestines of fishes (carp, &c.).

4. *Scolex.*—The body is flat and continuous; the head has four fossæ on it. It occurs also in the intestines and abdomen of fishes, sepiæ, &c.

5. *Gymnorhynchus.*—This genus has the body very long, with a globular receptacle at the neck; head with two opposite fossæ, and four naked retractile proboscces. The species occur in the muscular substance of many fish.

6. *Tetrarhynchus.*—Body flat, continuous, head with four fossæ and four retractile probosces, furnished with recurvated spicular processes. It occurs in reptiles, fishes, *Mollusca,* in the muscles, branchiæ, stomach, and its membranes, the liver, and peritoneum.

7. *Ligula.*—In its first stage of development the body is elongated with a longitudinal fissure, without any appearance of head, or organs of generation. In its perfect state there is a simple fossa on each side of the head, and the ovaries and processes form a single or double row along the median line. The species occur very frequently in birds and fishes, but very rarely in *Mammalia.*

8. *Triænophorus* has the body elongated, flat, sub-articulated; mouth bilabiate, and furnished on each side with two tricuspid acicular processes. It is found in fishes.

The *Trematode* order is divided into six genera, which also include only two species infesting the human body.

1. The first genus is *Monostoma,* which has only a single anterior pore. It occurs in *Mammalia,* birds, reptiles, and fishes.

2. *Amphistoma* is furnished with two pores, one anterior and one posterior. Found in the stomach, intestines, and abdomen, and in the hydatids of the viscera of mammals, birds, and reptiles.

3. *Distoma.*—In this genus there are two pores: an anterior and a ventral. An immense number of species are known, occurring in *Mammalia,* birds, fishes, &c. The *D. hepaticum,* or Fluke-Worm, frequents the gall-bladder and ducts very frequently in some animals, as the ruminating, and is particularly common in the sheep in the disease called the Rot. It has been discovered in the gall-bladder of the human subject, though very rarely. It bears a considerable resemblance in its shape to a melon-seed, being flat, and appearing lanceolate at each end, as seen with the naked eye, though, when magnified, the extremities are found to be obtuse, the tail being the broader of the two. The anterior pore, or true mouth, is round and small; the posterior cavity is imperforate, and only subservient to adhesion and locomotion; it is situated in the ventral aspect of the body in the anterior half. Between these there is a third orifice, destined to the generative system, and from which a small cylindrical process is generally protruded. The Fluke is hermaphrodite and oviparous: it lives upon the bile, which is absorbed by the mouth, and is at once so digested or modified by the vessels which go off from thence, as to become immediately fitting nourishment for the animal.

4. *Tristoma* has three pores, the anterior simple, and the posterior radiated. It is found in the gills of one or two species of fish.

5. *Pentastoma.*—The mouth is here situated between two pores on each side, through which a spicular process comes out. It occurs in the frontal sinuses, lungs, and surface of the liver of the *Mammalia* (dog, horse, wolf), and in reptiles.

6. *Polystoma.*—This genus has six anterior pores, besides a ventral and posterior one. It mostly occurs in the throat and branchiæ of fishes, and the bladder of frogs; but one species, the *P. pinguicola,* was discovered by Treutler in the cavity of an indurated adipose tubercle, in the left ovarium of a female aged 20, who had died in child-bed. The tumour, which was apparently formed entirely of indurated fat, was of a reddish colour, and hollow within; the cavity was nearly filled by the above-named worm, which was about half an inch in length, and between one and two lines in width.

The 4th order, *Acanthocephala,* contains but one genus, *Echinorhynchus,* to which belong numerous species occurring in all classes of vetebrate animals except man. They are generally found in the intestinal canal, fixed between its membranes, and occasionally even in the peritoneal cavity; they have also been found in the neck under the skin.

We now come to the last and most highly-organised group of the *Entozoa,* the *Nematoidea,* which contains a greater number of genera, and includes more species inhabiting the human body than any of the preceding. It has been divided into 11 genera, namely:—

1. *Filaria.*—These are of nearly equal thickness throughout their whole length. They occur in all parts of the *Vertebrata,* though principally in the cellular membrane; they are also even found in insects and their larvæ.

2. *Trichosoma.*—On its anterior extremity, which is very thin, is the mouth, resembling a minute point. It is found in *Mammalia* birds, and *Amphibia,* between the coats of the stomach, in the intestines, and the urinary bladder.

3. *Trichocephalus.*—This genus differs from *Filaria* in the capillary form of the anterior part of the body, and in its swelling out behind. It occurs principally in the cæcum of the *Mammalia.*

4. *Oxyuris* is characterised by being subulate posteriorly, having the mouth orbicular, and the penis in a sheath. The *Ascaris vermicularis* is included in this genus by Bremser.

5. *Cucullanus* is attenuated posteriorly. It occurs in the intestines and abdomen of reptiles and fishes.

6. *Spiroptera* is attenuated at each end. It occurs under the nictitating membrane of birds, in various parts of fish, and is said to have been found in the urinary bladder of man.

7. *Physaloptera* is attenuated at both extremities; the tail of the male is bent downwards, winged, and furnished below with a sort of bladder. The species are found in the stomach of *Mammalia,* birds, and reptiles.

8. *Strongylus.*—This has both ends attenuated: the tail of the male termintes in what Rudolphi calls a bursa, and through this the penis passes out. It occurs frequently in various situations in the three first classes of vertebrate animals.

9. *Ascaris.*—This genus, which is the most numerous of the intestinal worms, 80 species having been already described, has the extremities attenuated, the mouth furnished with three valves or tubercles, and the penis double. The species occur in almost every part of the bodies of vertebrate animals.

10. *Ophiostoma* is attenuated at the extremities, and has the mouth furnished with two lips. It is found in the intestines of *Mammalia* and fishes.

11. *Liorhynchus* has the mouth at the end of a sort of erectile and polished tube. It occurs in the stomach and intestines of some of the *Mammalia* and of many fishes.

In the above list of the genera of the cavitary, intestinal, or round worms, we have not made any particular mention of the species parasitic in man, and as several of them possess considerable interest, we need no apology for giving a short description of them. We may begin with the genus *Filaria,* three species of which are enumerated as human inhabitants, though two of them have been only once detected. The Guinea-Worm (*Filaria Medinensis*) frequently occurs in hot climates, but the countries where it most abounds are Arabia, Upper Egypt, Abyssinia, and Guinea. Its general habitation is the subcutaneous cellular tissue, particularly of the lower extremities; but it is also found in the scrotum, and very rarely beneath the tunica conjunctiva of the eye. The length of this worm varies from six inches to twelve feet: it is about as thick as the string of a violin. Its colour is generally white, but occasionally brown; it is round, and of nearly equal dimensions in its whole length, but becomes a little attenuated towards the anterior extremity. The tail of the male is obtuse, and armed with a spiculum; in the female it is acute and bent. The mode of development of this entozoon is unknown. It seems that it may exist for many months without being detected, cases occurring where it has not been discovered till more than a twelvemonth after leaving the country where it was contracted. After a time it produces irritation; in some point of the skin a vesicle, pustule, or small abscess forms, breaks, and then the end of the worm makes it appearance, which may be taken hold of, and cautiously and gradually extracted. If the *Filaria* is broken, the portion remaining beneath the skin dies, and produces inflammation, sinuous abscesses, and often great constitutional disturbance, requiring amputation of the limb. It seems to be capable of slowly shifting its situation in the cellular membrane. According to Rudolphi, its coming out through the skin is not to be attributed to perforation of that membrane, which it is not at all capable of effecting, but only to the irritation which it excites in approaching the integuments. It seems sometimes to affect people within the tropics in an endemic or even epidemic form, nearly half the men in a regiment having been attacked at the same time by it. This species has been mentioned as having been found occasionally beneath the conjunctiva of the eye; but another, and much smaller kind, has been detected within the eyeball itself, namely the *F. Oculi Humani,* which Nordman met with in the liquor Morgagnii of the capsule of the crystalline lens of a man who had had the operation of extraction for cataract performed. Two minute worms were discovered coiled up together. This species differs from the large *Filaria* found in the eye of the horse. The third species is the *F. bronchialis,* which was once detected in the enlarged bronchial glands of a man by Treutler; its length was about an inch.

Recently species of *Filaria* with *Monostomata*, *Distomata*, and *Infusoria*, have been found in the blood of animals. Gruby and Delafond have found *Filaria* in the blood of dogs. The results at which they arrived may be shortly stated in their own words as follows:—

1. The number of microscopic *Filariæ* inhabiting the blood of certain dogs may be estimated approximately at from 11,000 to about 224,000. The mean number, deduced from 20 dogs, was more than 52,000.

2. The microscopic *Filariæ*, having a diameter less than that of the blood discs, circulate in the most minute capillaries where the blood discs can find entrance. A drop of blood taken from these vessels, it does not signify at what part of the body, nor at what season of the year, contains these minute *Hematozoa.*

3. The chyle and the lymph of dogs, whose blood contains microscopic *Filariæ*, present none.

4. Nor do any of the secretions or excretions.

5. Nor in the dissection of 28 dogs of different sorts and ages, and whose blood was known to have been verminous for periods varying from several months to more than five years, and made with the utmost care, were any *Filariæ* ever discovered in any of the tissues. Their proper habitat seems to be exclusively in the blood-vessels.

6. The authors calculate, from the examination of 480 dogs, that the blood in about four or five per cent. is verminous.

7. It is so more frequently in old and adult dogs than in young ones.

8. The verminons condition seems to be irrespective of racc, sex, or geueral habit of body.

9. Even when most abundant, this condition of the blood does not seem to interfero with the instincts or muscular force of the animal.

10. Nor is the constitution of the blood itself altered.

11. Transfusion of verminous blood, dcprived of fibrin, into sound animals, was not followed by any result. But,

12. When unaltered verminous blood was thus injected, *Filariæ* were found living in the animals experimented on, for more than three years, or until their natural death.

13. *Filariæ*, transfused with defibriuated blood into two rabbits, lived in the blood of those animals for 89 days; after which time none could be found.

14. In a similar experiment with six frogs, two of which already had *Filariæ* in their blood, the canine *Filariæ* lived for eight days, during the whole of which time the blood-discs of the dog appeared unaltered among those of the frog. On the ninth and tenth days the dog's blood-discs having become changed, the *Filariæ* had disappeared, and the frogs died of a scorbutic malady (!).

15. Injected together with the blood into the serous cavities or cellular tissue of dogs, in good health, the *Filariæ* could not live in their new domicile.

16. A verminous dog, of one race, with a female not so affected, of another, had offspring of which those belonging to the paternal race were verminous, and the others not.

17. When the conditions were reversed, so was the result.

18. But the *Filariæ* in the blood of the descendants could not be detected till the dogs were five or six months old.

The authors have also succeeded in finding in the verminous blood of a dog which died in consequenco of its being fed exclusively on food composed of gelatine, large worms, visible to the naked eye. They found six, of which four were fcmales and two males, and they were lodged in a large clot occupying the right ventricle of the heart. The worms were white, from 0·5 to 0·75 inch long, and from 0·039 to 0·058 inch in diameter. They propose for this hematozoon, the name of *Filaria papillosa hæmatica Canis domestici.*

The *Trichocephalus dispar*, or Long Thread-Worm, is about an inch and a half or two inches in length, the male being smaller than the female. The capillary portion makes about two-thirds of the whole length of this species. This worm is very common in the cæcum and large intestines, but does not seem to occasion any inconvenience, though inflammation of the intestinal follicles and fever has been erroneously ascribed to it. The existence and history of the following entozoon are involved in a good deal of mystery. *Spiroptera Hominis* is the name given to some small intestinal worms which were sent to Rudolphi, together with some other vermiform bodies of an elongated form and solid homogeneous texture, which were passed from the bladder of a poor woman then living in St. Sepulchre's workhouse, London. There were also discharged, together with these substances, numerous small granular bodies, considered by Rudolphi as mere morbid concretions, but which subsequent examinations have caused to be regarded as ova. The small nematoid worms, which were six in number, and of different sexes, are supposed to have been expelled from the woman at the same time; they were from eight to ten lines in length, slender, white, and elastic; the other elongated bodies varied in length from four to eight inches. Some of the latter substances and ova are preserved in the Museum of the College of Surgeons; but none of the former *Entozoa*, denominated *Spiroptera Hominis*, are to be found among them.

The *Strongylus gigas* also inhabits the urinary apparatus. Before Rudolphi's time it was generally confounded with the *Ascaris lumbricoides*, to which it bears some resemblance. It occurs, though rarely, in the substance of the kidneys, where it sometimes attains an enormous size, having been met with three feet long, and half an inch in diameter. The more ordinary dimensions however are about fifteen inches in length and two lines in thickness. The common colour is blood-red, arising from the nature of their food, as they obtain their nourishment from the contents of the renal vessels: they occasionally find their way into the bladder, and are discharged with the urine. This entozoon occurs much more frequently in some animals, as the dog, horse, &c., than in man. Their presence in the kidneys does not seem to give rise to any peculiar symptoms differing from those of other renal diseases.

The *Ascaris lumbricoides*, the Common Round Worm so frequently met with in children, is so well known as to require a very brief notice here. It occurs in the hog and the ox, as well as in man, and chiefly inhabits the small intestines. The male is smaller than the female, and much more rare; it may be distinguished by the end of the tail being curved, and terminating in an obtuse point, at the apex of which a small black speck may be frequently observed. In the female this extremity is straighter and thicker. The anus is situated in both sexes close to the tail. In the female there is generally a constriction in the centre of the body where the organs of generation are placed. This worm, when minutely examined, will be found to consist of integuments, muscles, digestive organs, genital apparatus, and a nervous system consisting of an œsophageal ring and a dorsal and ventral cord. It has been supposed to feed on the chyle or mucus in the intestines, and to adhere to the coats of the bowels, but on these points there is considerable doubt. They are often found in great numbers.

The last human species in this group is the *Ascaris vermicularis*, the Maw-Worm, Thread-Worm, or Ascarides. It is very minute, the male seldom exceeding two lines, and the female five lines in length, and being proportionally slender. Their colour is white; they are so small that there is great difficulty in detecting their structure, but Rudolphi says that he has repeatedly observed the three tubercles round the mouth characteristic of the genus. Their abode is the large intestines, particularly the rectum, where they sometimes occur in immense numbers, and occasion great irritation.

We have now enumerated all the genera of *Entozoa* described by Rudolphi and other entozoologists, but before we conclude our subject we will say a few words on the *Trichina spiralis* which we have before mentioned. It is a microscopic parasite, infesting the muscles of the human subject belonging to the voluntary class, and found in greater numbers in those that are superficial than in the deep seated. Their nidus seems to be in the inter-fascicular cellular tissue. A portion of muscle affected by these animals appears beset with whitish specks, which, if examined with a microscope, are found to be little cysts containing a minute worm coiled up. The cysts are of au elliptical shape, and attenuated towards the extremities: their length is about $\frac{1}{50}$th of an inch, and breadth $\frac{1}{100}$th. By cutting off one extremity of the cyst, the *Trichina* may be extracted entire, when it is generally found rolled up in two or two and a half spiral coils. Being straightened out, it will be found to measure $\frac{1}{30}$th of an inch in length and $\frac{1}{700}$th of an inch in diameter. From the minuteness of the object it is necessary to employ a magnifying power of considerable intensity to examine it satisfactorily, and from the difficulty of managing the investigation, and the deceptive appearances produced under the microscope, it is not easy to detect its organisation. Professor Owen never succeeded in discovering an intestinal tube, or cavity, and therefore, as we have stated, placed this entozoou in his first group along with the seminal animalcules. ('Zool. Trans.,' vol. i.; and 'Zool. Proceedings,' February, 1835.) Dr. Arthur Farre observed, by very patient and minute observation with the microscope, under favourable circumstances, that it possesses an intestinal canal with distinct parietes ('Med. Gazette,' Dec. 1835), and upon this ground it ought to occupy a higher station among the nematoid or intestinal worms; but further researches are necessary before it can be stated with confidence in which group this entozoou should be placed. It seems that this parasitical affection of the humau body is unconnected with age, sex, or any particular form of disease, aud it appears that it may exist without giving rise to any debility of the vital powers, or even without interfering with the enjoyment of robust health.

For an account of the diseases produced by *Entozoa*, and their remedies, see ANTHELMINTICS, in ARTS AND SC. DIV.

EOCENE. The lowest of three great divisions of Tertiary Strata is thus termed by Sir Charles Lyell. [TERTIARY STRATA.]

EOLIDÆ. [NUDIBRANCHIATA.]

EOLIS. [NUDIBRANCHIATA.]

EPACRIDA'CEÆ, *Epacrids*, a natural order of Monopetalous Exogenous Plants, very closely allied to *Ericaceæ*, with the small-leaved genera of which they entirely agree in habit, and from which they are scarcely distinguishable by any character beyond their anthers being in all cases one-celled. Dr. Brown, in founding the order in the year 1810, explained his motives for doing so as follows:—"The family of *Ericeæ* is now so vast that it seems to constitute a class rather than an order, of which one part, although not a very natural one, has been already separated by Jussieu under the separate name of *Rhododendra*, on account of some diversity in the structure of the fruit. I therefore may be allowed to propose another order (*Epacrideæ*), which is truly natural, although it depends upon the single character of the unusual simplicity of the anthers; a character however which is of the greater value as opposed to the 2-celled anthers of *Ericeæ*, which are generally divided and furnished with appendages. The propriety of the measure is moreover confirmed not only by the number of *Epacrideæ*, large as it is, but also by their geographical disposition; for all, as far as we at present know them, are inhabitants of Australasia or Polynesia, countries in which not more than one or two species of *Ericeæ* are found." ('Prodr.' p. 536.)

Sprengelia incarnata.

1, a flower with a calyx as long as the 5-parted corolla, and several bracts imbricating the base; 2, an anther; 3, the stamens and ovary.

The species consists of shrubs with alternate or occasionally opposite leaves, which are either articulated with the stem, like those of *Ericeæ*, or broad at the base and half-surrounding the stem in a kind of hood or sheath. Their flowers are usually monopetalous, but as in the order *Ericaceæ*, it is not unfrequent to find them with their corolla divided or divisible into several pieces, and therefore truly polypetalous. The size and colour of the corolla are often striking, and the species then become exceedingly showy, and are favourites with gardeners. None of them are of any particular use, unless those are considered an exception whose succulent fruit is eatable, like *Lissanthe sapida* and others, which constitute the Australian cranberries.

Dr. Brown mentions 24 genera and 144 species of this order in his work upon the 'New Holland Flora.' Dr. Lindley, in his 'Vegetable Kingdom,' gives 30 genera and 320 species.

EPENDYMA. [EPITHELIUM.]

EPERVA, a genus of Plants belonging to the natural order *Fabaceæ*. It has four thick and concave sepals connected together into a permanent urceolate tube at the base, with the sides incumbent, the upper one the broadest. It has but one petal, which is roundish, fringed, and inserted in the middle of the calyx. There are 10 stamens, which are long thickened filaments, rather villous at the base, and joined into a short monadelphous ring. The ovary is stipitate. The style long and filiform. The legume compressed, dry, coriaceous, falciform, 2-valved, 1- to 4-seeded. When young it is tomentose.

E. falcata is a tree with abruptly pinnate leaves, bearing 2 or 3 pairs of ovate acuminated shining leaflets. The panicle is pendulous on a long peduncle, constantly composed of numerous distant racemes. It is the Wallaba-Tree of Guyana according to Sir Robert Schomburgk, who informs us that its wood is deep red, frequently variegated with whitish streaks, hard, heavy, and shining, and impregnated with an oily resin which renders it very durable. The bark is bitter, and is used by the Arawaak Indians as an emetic.

(Lindley, *Vegetable Kingdom*; Don, *Dichlamydeous Plants*.)

EPHEDRA (the Greek name of the *Equisetum*, which this genus closely resembles), a genus of Plants belonging to the natural order *Gnetaceæ*. The species are diœcious; the male flowers are arranged in the form of a catkin, having a bifid calyx, and 7 stamens, 4 of the anthers of which are inferior, 2 superior; the female flowers have a quintuple calyx 2-parted, 2 ovaries, and 2 seeds covered over by the berried calyx. The species are not numerous, and are found in Europe, Asia, Africa, and America. The branches and flowers of the Asiatic species of this genus were formerly kept in the shops as styptics. The fruit is mucilaginous, eatable, subacid, and slightly pungent.

E. distachya has the sheaths of the joints 2-toothed, blunt, the catkins 2, opposite, stalked, the peduncles shorter than the catkins. It is a native of France and some parts of Germany, and abounds in the southern parts of Europe, and thence eastward to Persia and India. The berries, which consist of the fleshy calyx covering the ovarium, ripen in July and August. They have a sweetish taste, and contain a mucilaginous juice.

E. monostachya has the sheaths of the joints the same as the last, but the catkins either solitary or opposite, and the peduncles longer than the catkins. This plant is found in Hungary and Siberia, and in these countries the fruit is eaten as a great luxury.

E. altissima has clustered catkins and spreading branches, and is a native of Barbary.

There is an American species found on the borders of Lake Michigan in the country of the Chippeway Indians. It bears a large fruit.

(Burnett, *Outlines of Botany*; London, *Encyclopædia of Plants*.)

EPHE'MERA (ἐφήμερα, living for a day), a genus of Neuropterous Insects belonging to the family of *Subulicornes* of Latreille. They have long soft tapering bodies, terminating in two or three long setæ. Their wings are placed nearly or quite perpendicularly. Their antennæ are very small, and 3-pointed. In the larva state they live in wet places or under water, and enjoy an existence of two or three years; but when they attain their final stage of metamorphosis and perfect form, they are among the most fleeting of living creatures, existing often only a few hours, and propagating their species before they die. In this state they sometimes appear suddenly in myriads, during fine summer evenings, by the water-side, where they may be seen flitting about and balancing themselves in the air, in the manner of gad-flies. (Westwood, *Introduction to Entomology*.)

EPHIALTUS. [MAIADÆ.]

EPHIPPUS. [CHÆTODON.]

EPHYRA. [ACALEPHÆ.]

EPIDENDRUM, an old name for all the Orchidaceous Plants which grow upon the branches of trees, and which are now called Epiphytes. [EPIPHYTES.] In its modern sense it is restricted to a considerable genus of the order with the labellum united to the column, and four pollen-masses adhering to as many little straps bent back upon them. Some of them are showy and interesting, particularly *E. Skinneri*, *E. oncidioides*, *E. cochleatum*, *E. aromaticum*, *E. bifidum*, and *E. auropurpureum*; but many are inconspicuous, and of no importance except to botanists. According to Sir R. Schomburgk the expressed juice of *E. bifidum* is a purgative, taken in doses of a table-spoonful at a time; it is also reckoned in Tortola an anthelmintic and diuretic.

EPIDERMIS (in Animals). [SKIN.]

EPIDERMIS (in Plants). [BARK; TISSUES, VEGETABLE.]

EPIDOTE, a Mineral consisting of silica, alumina, lime, iron, and manganese. It crystallises in right rhomboidal prisms, more or less modified, often with six or more sides. It is of a yellowish-green colour, with ash- and hair-brown. It is translucent to opaque. Lustre vitreous, a little pearly; often brilliant on the faces of the crystals.

There are three prominent varieties of this species: one of a yellowish-green colour; another called *Zoisite*, of a grayish-brown or hair-brown; and a third of dark reddish shades, which contains 14 per cent. of oxide of manganese, and is called *Manganese Epidote*. Another variety of a red colour is called *Thulite*. The yellowish-green variety is often called *Pistacite*. *Bucklandite* is an iron *Epidote*. The green Epidote has a composition as follows:—

Silica	37·0
Alumina	26·6
Lime	20·0
Protoxide of Iron	13·0
Protoxide of Manganese	·6
Water	1·8
	99·0

Epidote occurs in crystalline rocks, and also in some sedimentary rocks that have been heated by the passage of dykes of trap or basalt. It has been found principally in the United States of America.

(Dana, *Mineralogy*.)

EPILOBIUM, an extensive genus of Plants belonging to the natural order *Onagraceæ*. It is composed of herbs with opposite or alternate leaves; axillary or solitary flowers, or disposed in terminal spikes, each flower furnished with a bractea; the corollas purple, rose-coloured, or flesh-coloured. The calyx has four sepals connected in a long tube; the petals 4; stamens 8; the capsule linear, bluntly tetragonal, 4-celled, 4-valved, many-seeded, and inseparable from the calyx; the seeds pendulous and covered with pappus. About 45 species of this genus have been described: they are natives of the cooler parts and mountainous districts of Europe, Asia, and America.

E. angustifolium, Narrow-Leaved Willow-Herb, or French Willow, has a creeping root; erect nearly simple stem; sub-sessile lanceolate undulated glabrous leaves, with pellucid veins; the flowers bracteated in spicate racemes; the style reflexed, pilose at the base, and shorter than the stamens. It is found in mountains, woods, and meadows, in Europe and Siberia. In Great Britain it is found in moist shady places in the north of England and in the south of Scotland. It has crimson inodorous flowers, with blue pollen. It is a very ornamental plant, and is often introduced into gardens; but it requires great attention, as its roots spread very rapidly, and are got rid of with great difficulty. In Kamtchatka the pith of this plant is dried and boiled, and on being fermented is converted into ale and vinegar. The young shoots are said to be eatable, but the matured plant possesses narcotic properties. As this plant is very common in some places, two or three varieties have been observed and described.

E. hirsutum, Hairy Willow-Herb, or Codlings-and-Cream, has creeping roots; branched hairy stems; lower leaves opposite, upper ones alternate, ovato-lanceolate, hairy, toothed, half stem-clasping; stigma 4-cleft, the segments deflexed. This plant is found in wet places in Europe and Siberia. In Great Britain it is a common plant in ditches, on the margins of rivers, amongst reeds and coarse grasses. The whole plant is downy and clammy. It exhales a peculiar acidulous scent, which, from its resemblance to that dish, has procured it the name of Codlings-and-Cream. This scent is not unlike that of hot apple-pie.

The other British species of this genus are *E. parviflorum*, *E. lanceolatum*, *E. montanum*, *E. palustre*, *E. variegatum*, *E. tetragonum*, *E. roseum*, *E. alsinifolium*, and *E. alpinum*.

Although this genus is numerous, the species offer no great variety of character. None of them possess active medicinal properties, which is a character of the family to which they belong; nor do they yield secretions which render them available as food for man or beast. All of them are ornamental plants, and may be introduced into gardens. They require little care in their cultivation, as they will grow in any common garden soil, and may be easily propagated by sowing the seed or by dividing the roots.

EPIMEDIUM, a genus of Plants belonging to the natural order *Berberaceæ*, or *Berberideæ*. It has a calyx of 4 deciduous sepals; 4 petals; 4 cup-shaped nectaries; the capsule pod-like, many-seeded. The species are herbs with creeping perennial roots and annual stems.

E. alpinum, Alpine Barrenwort, has no root-leaves, and the leaves of the stem twice ternate. It is a native of France and other parts of Europe in sub-alpine coppices and woods. It has been found growing in Great Britain in Cumberland and Yorkshire, but Mr. Babington remarks that it has very slender claims to be considered a native of England or Scotland. The flowers are red, with yellow nectaries. The stem is about four inches high. Its somewhat bitter leaves were formerly regarded as sudorific and alexipharmic.

E. pinnatum is a native of Persia, and *E. hexandrum* of the north-west of America. The first species is easily cultivated, and will grow in any common garden soil, and may be propagated by dividing the root.

(Babington, *Manual of British Botany.*)

EPIPACTIS, a genus of Plants belonging to the natural order *Orchidaceæ* or *Orchideæ*, and to the tribe *Limodoreæ* or *Arethuseæ*. It has the perianth patent, the lip interrupted, the basal division concave, the terminal one larger, with two projecting plates at its base above; the stigma nearly square; the rostellum short, terminated by a globose appendage; the anthers terminal, erect, sessile, 2-celled, the cells without septa; the column short; the germen straight on a twisted stalk. There are two species of this genus found wild in Great Britain.

E. latifolia has ovate clasping leaves, the lower bracts longer than the flowers, the terminal division of the lip entire, with a minute point. Babington observes that there are four or more very different plants included under this species inhabiting various parts of Great Britain. These are:—1. *E. latifolia*, with the terminal division of the lip roundish, cordate, obtuse, with a small recurved point. 2. *E. media*, with the terminal division of the lip triangular-cordate, acute, as long as the lanceolate sepals and petals. 3. *E. purpurata*, with the terminal division of the lip triangular-cordate, acute, shorter than the ovate-lanceolate sepals and petals. 4. *E. ovalis*, with the terminal division of the lip transversely oval and acute.

E. palustris has lanceolate leaves, bracts shorter than the somewhat drooping flowers, the terminal division of the lip roundish, obtuse, crenate, as long as the perianth. It is found in Great Britain in moist places, and is not a rare plant.

These plants will thrive in the borders on common garden soil, and will also grow in pots with a mixture of loam and peat; they require but little water when not vegetating, and may be propagated by division of the roots.

(Babington, *Manual of British Botany;* Loudon, *Encyclopædia of Plants.*)

EPIPHE'GUS (from ἐπί, upon, and φηγός, the beech, because the plant is parasitical on the roots of the beech), a genus of Plants belonging to the natural order *Orobanchaceæ*. It has the sterile flowers perfect, and the fertile flowers imperfect; the calyx short, 4-toothed; the perfect corolla 2-lipped; the upper lip emarginate, the lower 3-toothed; the imperfect corolla slender, 4-toothed, deciduous; the stamens as long as the corolla; the filaments smooth; the anthers 2-lobed, acute at the base, valveless, dehiscent in the middle; the stigma capitate, and somewhat emarginate; the capsule gibbous compressed, half 2-valved with four diverging placentæ. There is but one species, *E. Virginiana*. It is found parasitical on the roots of beech-trees in the southern states of the American Union, where it is called Beech-Drops. It is the *Orobanche Virginiana* of Linnæus. It is a smooth fleshy branching plant, growing from 6 to 18 inches high, and clothed with small scales instead of leaves. The corolla is purple streaked with white. The capsule dilates after it opens into the shape of a cup. There is in North America a quack medicine called 'Martin's Cancer Powder,' which consists of equal parts of this plant and white arsenic. It is said by some writers to have a beneficial effect. (Lindley, *Flora Medica;* Don, *Dichlamydeous Plants.*)

EPIPHLEUM. [BARK.]

EPIPHYLLOSPERMOUS PLANTS, so called by the old botanists because they bore their seed upon the back of their leaves. They are what have more recently been called Dorsiferous Ferns. [FILICES.]

EPIPHYTES are plants found growing upon other vegetables, adhering to their bark, and rooting among the scanty soil that occupies their surface, in which respect they are distinguished from parasitical plants, which, like Mistletoe and the various species of *Loranthus*, strike their abortive roots into the wood, and flourish upon the blood of the individual to which they attach themselves. In this sense of the word, Mosses, Lichens, Ferns, and plants of many other families, are Epiphytes; but as in this country at the present day the word is principally employed with reference to those *Orchidaceæ* which grow upon trees, it is to plants of that description that we propose to devote the present article.

It had long been known, from the reports of travellers, that Orchidaceous Epiphytes were plants of extremely curious organisation, and that great numbers were also remarkable for the singular beauty and fragrance of their flowers; but when imported into this country, their habits were found to be so unlike those of other plants, that no gardener could succeed in keeping them even alive for any considerable time, except in a very few instances; and it was not till about the year 1820 that the real method of managing them successfully began to be understood. About that time Mr. Cattley and Dr. Lindley began to direct their attention to the subject with some success. Since that period the difficulties of cultivating Orchidaceous Plants have been gradually disappearing, and at the present day they may be said to be almost entirely overcome; so that in the gardens of the Duke of Devonshire at Chatsworth, of Mr. Bateman at Knypersley, of Lord Fitzwilliam at Wentworth, of Mr. Harrison of Liverpool, and of many other amateurs, they have acquired a beauty quite unknown to them in a wild state. Species which in their native woods yield no more than two or three of their curious blossoms in a cluster have been found to produce from nine to between twenty and thirty, and the whole order has in short been found willing to submit to domestication with as much advantage as has ever attended roses, hyacinths, tulips, or dahlias—those well-known flowers which we have from time to time reclaimed from their wild habits, and by the arts of cultivation invested with a splendour of appearance that never could have been anticipated from their original appearance in a savage state. Previously to the year 1820 it is doubtful whether any garden in England could at any one time have produced twenty species of these plants, but since that period more than a thousand have been successfully preserved in the collections of the Messrs. Loddiges, Rollisson, Knight, and other nurserymen near London.

We do not propose in this place to give any botanical account of these curious plants. For such particulars we refer to the article on ORCHIDACEÆ. Upon the present occasion we shall confine ourselves to an account of their natural habits, and of those methods of cultivation which appear to have met with so much success. In preparing the following account, we depend in part upon our own experience, in part upon the information contained in the writings of botanical travellers, and in part upon the useful communications which within the few last years have been made to the current horticultural publications, especially the 'Transactions of the Horticultural Society' and the 'Gardeners' Chronicle.'

Orchidaceous Epiphytes grow naturally upon trees in the recesses of tropical forests. They establish themselves upon the branches, and either vegetate amidst masses of decayed vegetable and animal matter, or cling by their long succulent grasping roots to the naked branches of trees, from which and the humid atmosphere together they exclusively derive their food. It appears from the testimony of Mr. Henchman that they are never found upon dead erect trees in forests; but if upon dead wood at all, then only upon fallen trunks, which, from their situation near the ground, are constantly damp. Such situations are however said to be by no means favourable to their growth. They will also flourish upon rocks and stones in hot and damp climates. Mr. W. Harrison of Rio Janeiro is said, by one of the Horticultural Society's collectors who visited him, to have cultivated with the most perfect success above seventy species upon a wall in his garden at Boto Fogo.

We even see some of them germinate and grow most luxuriently in damp places, in the stove, upon the sides of the garden-pots, and among gravel; some genera, such as *Brasavola*, are even reported to prefer stones; and Dr. Wallich found them in all cases growing equally well in Nepaul upon trees and stones, provided the latter had a certain quantity of mould and moss adhering to them. In the botanic garden at Calcutta they are said to be cultivated with success in raised beds of solid brickwork, so contrived as to insure a perfect drainage; the soil being rich vegetable matter mixed with at least two-thirds small pebbles, and covered with a dense layer of moss. A certain quantity of shade seems, in many cases, essential to them, their natural situation being in forests, or among the branches of growing trees. In Brazil numbers of them occupy damp woods and rich valleys, among vegetation of the most luxuriant description, by which they are embowered. Reinwardt describes others as inhabiting in great abundance those deep shady gloomy forests which form the lower zone of vegetation in Java, where the air is heavy and damp with vapours that cannot ascend, and where the thickness of the vegetation is really frightful; where, in short, heat, moisture, and a most extraordinarily deep and rich vegetable soil combine to produce wood of a fungus-like softness and an inconceivable abundance of Twining Plants and Epiphytes. In those forests more especially where huge fig-trees constitute the principal part of the timber, intermingled with the most tropical forms of vegetation, such as *Sterculiaceæ*, *Sapindaceæ*, and *Artocarpaceæ*, tufts of Orchidaceous Plants abound, in company with *Araceæ*, *Acanthaceæ*, and *Zingiberaceæ*.

In Nepaul Dr. Wallich states that Orchidaceous Epiphytes grow in company with Ferns; and the thicker the forest, the more stately the trees, the richer and blacker the natural soil, the more profuse the *Orchidaceæ* and Ferns upon them. There they flourish by the sides of dripping springs, in deep shady recesses, in inconceivable quantity, and with an astonishing degree of luxuriance. It would however be a great error to suppose that it is only in very shady places that Orchidaceous Epiphytes appear. On the contrary, it is probable that the cases just cited are extreme, and that they more commonly prefer situations where the broken rays of the sun can readily reach them. Mr. John Henchman states ('Gardeners' Mag.,' ii. 139) that he has observed in Demerara "That *Orchidaceæ* appear to rejoice in a light situation and a free circulation of the atmosphere; but are decidedly adverse, with few exceptions, to exposure to the intense rays of the sun. We may except from this remark *Oncidium luridum*, the Catasetums, and a fine pseudo-bulb found on the Spanish Main (which I suppose to be an *Epidendrum*), which seem not only to exist, but to rejoice, in exposure to the sun." Mr. Bateman also found, from the report of his collector, Colley, that the situations in which they are most usually seen are those parts of a forest where old and broken wood occurs, or on the skirts of savannas. These savannas are large open breaks in the woods, covered with fine white sand, which has at night the appearance of snow. They contain also many low and stunted bushes. The *Orchidaceæ* seem to like an airy and exposed dwelling-place; being found on the more prominent parts of a tree, and not in the shade, as is generally supposed. Mr. Colley only found in one instance an Orchidaceous Plant in the heart of a forest, and this was growing on the prostrate trunk of a tree so rotten as to fall to pieces when pressed with the foot. ('Gard. Mag.,' ii. 4.)

This quite corresponds with the statements of travellers in Brazil, who speak of their occuring most abundantly in open glades of the forests, and on the faces of naked rocks, or on shaded banks, although they are also met with "in sombre glades where heated vapours are incessantly circulating."

Where the climate suits them, they are sometimes prodigiously numerous. Descourtilz, in his manuscripts, speaks of a whole tree being overrun with a single species; and Henchman also assures us that in Demerara masses of *Oncidium altissimum* and *Maxillaria Parkeri* are to be seen, which would defy any attempt at intrusion; on the Spanish Main he saw the Epiphyte commonly called the Spread-Eagle, clasping enormous trees, and covering them from top to bottom; and he also met with two or three species, supposed to be Maxillarias, which were growing with uncommon vigour. "But," he adds, "with the above exceptions, I have not found *Orchidaceæ* growing in such quantities as it has been reported they do; often, as Mr. Bateman justly observes, single specimens only are to be obtained. This cannot be more strongly illustrated than in the case of a beautiful *Oncidium*, which I was happy enough to meet with on the Spanish Main; its leaves are nearly six inches in width, of a very firm texture, and possessing an uncommonly strong nerve; and though the plant, judging from the remains of the original stem, which had gradually decayed as the plant progressed, must have occupied its station for nearly half a century, yet I searched the neighbourhood in vain for another specimen, nor did I see another plant of it on the Main."

This altogether corresponds with what we know of such plants in other countries, and with the general habit of the whole order, which is extremely local in the majority of cases. Upon comparing the Orchidaceous Plants of Java, of Ceylon, and of the Birmese country, it is quite extraordinary how few species those countries possess in common; and the quantities of species found exclusively in every large collection are a corroboration of the same fact. Mr. Bateman assures us that in Guyana "a river may be ascended for twenty miles without an Orchidaceous Plant being seen; while, on a sudden turn of the stream, every tree becomes covered with them: yet they do not appear to have a favourite aspect; for on some of the rivers which Mr. Colley visited he found them exclusively on the northern exposure, while on others they occupied the southern." The part of the tree on which they are principally found is as uncertain as their station. It is said that they love the loftiest branches, and are hardly found near the bottom, and M. Descourtilz confirms this statement by describing some of them as swinging in the air from the top of the old patriarchs of the forest, or exposed to all the violence of storms in the most exposed situations. But Mr. Henchman asserts that in Demerara at least they "do not grow in such high situations upon trees as is generally supposed. Twenty or twenty-five feet is the greatest height, with few exceptions, at which I have seen them growing. Some of the bulbless Epidendrums, the Spread-Eagle Plant, and *Oncidium papilio*, attain a much greater height. The other Oncidiums I have not seen growing above seven feet or eight feet from the ground, and generally on some of the small closely interwoven branches, and not on the stem or main branches of the tree. The various species of *Gongora*, *Coryanthes*, and *Rodriguezia*, are, almost without exception, found in the same position; while, again, the genera *Maxillaria*, *Fernandesia*, *Epidendrum*, *Ceratochilus*, *Cattleya*, *Zygopetalon*, *Brassavola*, *Ornithidium*, *Camaridium Pleurothallis*, *Brassia*, *Ornithocephalus*, *Trizeuxis*, *Catasetum*, and many other genera supposed to be new, I have found always attached to the trunk or strong limbs of the tree, which they clasp with surprising tenacity. It may be also observed that rough and soft barked trees are favourite habitats of *Orchidaceæ*. The Calabash-Tree, which has a peculiarly soft and woolly bark, often possesses many of the more minute species. Indeed, I sent home pieces of the Calabash-Tree, about a foot long, on some of which were six and on others seven distinct species of *Orchidaceæ*."

A high mean temperature throughout the year, and a climate either constantly humid or at least periodically so, are also atmospheric elements eminently favourable to the production of these plants. All those species which simply exist clinging by their roots to the branches of growing trees, and probably others also, must necessarily derive their nourishment in a great measure, if not entirely, from the moisture, in a very elastic state, that surrounds them. And although nature seems in general to have provided for the scantiness of their food by the construction of them with a cuticle only capable of parting by slow degrees with the fluid they receive by their roots, yet it is obviously requisite that they should be so situated as to be within reach of an abundant supply, not only at the time when they are growing, but also at all other times to a certain extent. Hence we find that the hottest countries if dry, and the dampest if cold, are destitute of them; while there is no instance of a country both hot and damp in which they are not plentiful. For example, in Africa they are unknown in its sandy deserts and parched atmosphere, notwithstanding the high temperature of that part of the world; yet they abound in Sierra Leone, where the climate is damp; and even at the Cape of Good Hope they occur not unsparingly in all that jungly district to the eastward of the Cape Town to which the name of Outniqualand is applied.

In the West India Islands they exist in great quantities, particularly in Jamaica and Trinidad; not however so much on the coast as upon the lower ranges of hills. This is in conformity with their habits elsewhere: in these islands the air of the level of the sea is dry, while that of the mountains is humid. Captain Sabine found the air of the level of the sea at Trinidad indicate 5° of dryness, and that of Jamaica 7°; while the atmosphere was saturated with humidity in the first of these islands at 1060 feet above the level of the sea, and in the second at an elevation of 4080 feet. At Rio Janeiro the mean temperature is 74° 3′, and much higher inland; the woods are so damp that it is difficult to dry plants; and in such situations multitudes of Orchidaceous Epiphytes spring up. But in the immediate vicinity of Buenos Ayres, where the mean temperature is 67° 6′ and the air dry, they are unknown; and in the high dry land of Mendoza, where the aridity is still greater, the whole order disappears, with the exception of a single species. On the west coast of South America, as high as Lower Peru, Orchidaceous Epiphytes are unknown; a circumstance which is not surprising when we consider the effect of the currents setting round Cape Horn, which bring the mean temperature of even Lower Peru itself down to 60° at night, and how arid the whole of that region is with the exception of a few valleys. No country however exhibits in a more striking manner than India the necessity of a hot and damp climate for the production of Orchidaceous Epiphytes. In the Malayan Archipelago, the mean temperature of which is estimated at between 77° and 78° and is very damp, they are found in profusion. In Nepaul it is upon the sides of the lower mountains that they occur, where they vegetate amongst clouds and constant showers; while on the continent of India they are almost unknown, their place being occupied by parasitical *Loranthi*. The traveller finds himself in the morning on the dry plains of Hindustan, where the mean temperature is 80°, and where all the trees are destitute of *Orchidaceæ*; and at noon he is at the foot of the first range of the Nepaulese hills, where every tree teems with that class of plants. There are however places on the continent of India where they are not less numerous than in Nepaul; at the æstuaries of the Ganges, the Brahmaputra, the Irawaddi, and the rivers of Martaban, they exist in vast quantities; but all these stations are excessively damp. In the Botanic Garden at Calcutta they grow most vigorously during the rainy season, but in the fiercely hot season, which begins in March and lasts till the 10th of June, they perish notwithstanding all the care they receive. Madagascar and Mauritius offer similar evidence to the same effect.

While however these statements are applicable to a very large part of Orchidaceous Epiphytes, there are some striking exceptions that require to be pointed out, both with regard to atmospheric moisture and to the temperature requisite for their production.

Mr. Allan Cunningham has shown in the 'Botanical Register,' fol. 1699, that in Australia there are three of these plants which require a very dry atmosphere, and it is probable that others exist in other countries. "These are *Dendrobium æmulum*, Brown, an Epiphyte uniformly found upon the rugged trunk of *Eucalyptus resinifera*, or Iron-Bark, in the open very dry forest grounds of the older colony at Port Jackson; *Cymbidium canaliculatum*, Brown, which of late years has been observed beyond the tropic both at Moreton Bay and still farther to the southward at Hunter's River, growing upon the principal limbs of several of the *Eucalypti* in the dry open shadeless forest. These two Epiphytes flourish most luxuriantly in an extremely dry atmosphere, and flower usually in the summer season in their native wilds, the high temperature of which is oftentimes greatly increased by the blighting hot winds which not unfrequently prevail at that period from the north-west. The third is *Dendrobium undulatum* of Mr. Brown, a handsome species, originally discovered by Sir Joseph Banks at Bustard Bay, and which has been lately found on barren hills naturally clear of timber upon the banks of the Brisbane River at Moreton Bay, where the plant forms tufts on bare rocks exposed to the full heat of the sun, which during nine months of the year is very considerable on that part of the coast."

In many cases a much lower temperature than that hitherto spoken of is natural to these plants, and there are some instances where they are naturally accustomed to rigorous weather. In America their favourite station, according to Humboldt, is in the gorges of the Andes of Mexico, New Granada, Quito, and Peru, where the air is mild and humid, and the mean temperature is 63° to 67° Fahr. (17° to 19° Cent.). In these localities they are so abundant that, according to the authors of the 'Flora Peruviana,' above 1000 species might be found in Tarma, Huanuco, and Xauxa alone. It is therefore not surprising that one species, *Epidendrum conopseum*, should advance as far to the northward as the rice climate of Florida, where it grows on the bark of *Magnolia glauca;* nor that others should be found in the damp maritime parts of the government of Buenos Ayres. But it is more remarkable that an *Oncidium nubigenum* should occur at the height of 14,000 feet on the mountains of Peru, and that other species should, upon the authority of M. Descourtilz, be able to bear without difficulty the cold glacial winds of the high serras of Brazil. The same peculiarities occur in the eastern world. Reinwardt speaks of great quantities of *Orchidaceæ* in the Storax and Laurel woods of Java, growing along with *Nepenthes*, Rhododendrons, Magnolias, and Oaks, in a zone of vegetation whose lower limit is 3000 feet above the sea. *Dendrobium nobile, Renanthera coccinea*, and some others, bear the periodical cold of Canton, where it occasionally freezes; *Dendrobium catenatum* and *D. moniliforme* occur in Japan as far north as 37° or 38°, or the parallel of Lisbon, and are periodically subject to a very low temperature; and Dr. Royle met with the deciduous *Cœlogynes* and *Dendrobium alpestre* on the Himalaya Mountains at the height of 7500 feet, where snow sometimes lies in winter for a week or more. To the southward they not only occur in the latitude of Port Jackson, where the mean temperature does not exceed 66° 6′, but even in much higher latitudes. The beautiful little *Gunnia Australis* grows on the branches of shrubs in Emu Bay, in Van Diemen's Land, in about 41° S. lat.; and *Earina mucronata* extends to 45° 45′ S. lat., in "the very permanently damp woods which clothe the shores of Dusky Bay in New Zealand," where it was originally observed by Forster in Cook's second voyage, and where it has since been met with by Mr. Cunningham, whose words we quote.

Such are the more important data that we possess to guide us in the cultivation of Orchidaceous Epiphytes; the result of which is, that they are kept in this country in stoves the air of which is maintained in a state of constant moisture, and at a temperature varying from 56° to 90° or more. The requisite uniformity of their atmosphere is provided for by keeping the houses but little ventilated, and the glass of the roof well puttied at the junction of the squares. Shade is secured either by moveable laths or by a screen of netting or coarse canvass, or by some such contrivance; some even grow their plants in a house exposed only to the north, but it does not appear that this plan is a good one; for it is an object not only to exclude excessive light, but also to be able to admit it if requisite, and this cannot happen in a hothouse with a northern aspect.

The soil in which the plants are made to grow is peat or some other kind of decayed vegetable matter, thoroughly drained, and yet so compact as not to be liable to become dry by excessive loss of water. In many cases it is found advantageous to make the plants grow upon the apex of a truncated cone of earth rising several inches above the rim of the pot. Certain kinds are suspended in baskets, or in frames so contrived as to be filled with moss and decayed vegetable mould rammed in very tight; and provided that precaution is attended to, the caulescent drooping species, especially Dendrobiums and Vanda-like plants, thrive admirably; but in general it is found most advisable to plant in earth in common garden-pots. Attempts have been made to grow some species on decayed dead wood, but they are generally abandoned now; nor have the trials to cultivate them on the branches of living trees hitherto proved more successful. The orange-tree was employed for this purpose by Mr. Lance with great success in Surinam, but in the hothouse it does not appear to suit them.

By attending to the natural habits of these plants, and observing the precautions just pointed out, the management of Orchidaceous Epiphytes has been brought quite within the skill of any good gardener. There are however two or three capital points about which cultivators entertain great difference of opinion.

The first is temperature. Some allow the thermometer to rise to 100° and higher in a summer's day, and never suffer it to fall below 65°; the consequence of which is, that their houses are so unpleasant that few persons can visit them to inspect the beautiful objects they contain. Others keep the temperature of even midsummer down to 80° at the most, and permit the minimum heat to be low in proportion; their houses are consequently cool and pleasant at all times. If we must admit that the first practice is eminently successful with some, so is the other most assuredly so with others; and we entertain no doubt that in the end it will be the only method followed.

The second question is the amount of moisture. Some form water-tanks in their houses, the evaporation from the surface of which keeps the air continually at the point of saturation; others simply keep the air sensibly moist by syringing or similar devices: the first is accompanied by a high, the latter by a moderate, temperature; in this case also we incline to believe that the latter practice is the best. The fact is that it may be reasonably doubted whether it is right always to follow nature literally in what we suppose to be her practice, and whether we ought not rather to adapt the management of our plants to the new and artificial condition under which they are placed. Keeping plants in a state of constant excitement by exposure to an excessive climate is a certain means of weakening them in the long run, and may be compared to keeping an animal always awake. It may be very true that this may seem to happen in nature; but does it really happen? Is it not probable that the long diurnal darkness of a tropical situation may be intended as a compensation for the high excitement of daylight? and are not we, with eighteen hours' daylight in summer, in an essentially different position from what Orchidaceous Epiphytes from equinoctial regions are exposed to in a wild state? Moreover, it can hardly be doubted that a moderate temperature is sufficient for them, even if they can be made to bear an excessive climate.

The third unsettled point is of another nature. In our hothouses we often maintain a high temperature all the year round, keeping our stove-plants growing from January to December. In nature this hardly ever happens. If a country has no winter it has its dry season, during which plants become more or less torpid. This is quite the case in all the countries inhabited by Orchidaceous Epiphytes, with the exception of some of the temperate parts of Mexico, where the climate is equal and mild. Should we not therefore give such plants, when cultivated, a similar period of repose? About this the opinions of cultivators are so much divided that we cannot say on which side the majority of votes would go. Mr. Bateman calls attention to the fact, in his account of Colley's mission to Guyana. "In consequence," he says, "of the unexampled length of the dry season, scarcely an orchidaceous plant was seen in flower, or a pseudo-bulb which had not lost its leaves. When however the rains had commenced, that is, in the month of July, the *Orchidaceæ* were pushing rapidly into flower, as were also some of those collected by Mr. Colley, which reached this country in as dry and shrivelled a state as Dutch bulbs usually come over in. This may afford a hint for their cultivation."

And Henchman, in like manner, urges the circumstance upon the consideration of gardeners.:—

"The atmospheric changes," he says, "are very great in tropical climates; and as I consider that *Orchidaceæ* derive their main support directly from the atmosphere, I think too much attention cannot be paid to the various changes by which they are in their natural state liable to be affected. One of the principal objects kept in view by growers of *Orchidaceæ* appears to be the keeping up a regular heat in the stove. Nothing can be more contrary to nature; for in the tropics, to a sultry day, with the thermometer standing at from 85° to 95°, succeeds a cool night and a cold morning, the thermometer falling to 60° or 55°; effecting in twenty-four hours a change of temperature of from 20 to 30 degrees. During the dry season, periods of two, three, and often extending to five or six months, the whole nourishment derived by the *Orchidaceæ* must be communicated through the agency of the tree to which they are attached, or from the atmospheric moisture which is the effect of the action of the sun upon the dew which has fallen during the night and morning; for the situations generally occupied by *Orchidaceæ* preclude the possibility of the dew reaching them in its descent; and slight though the moisture be which is communicated through these channels to *Orchidaceæ*, it is nevertheless sufficient to retain the vital principle in the pseudo-bulb, though not sufficient to rouse it into action. The dry season then appears to act upon *Orchidaceæ* on much the same principle as our winter acts upon our trees, &c. It is for them a period of rest; and the pseudo-bulbs having been well ripened are ready, when the wet season has given them a sufficient stimulus, to push forth luxuriantly both leaves and flowers." Nevertheless some of our best gardeners object to the plan of periodical resting; and, it must be added, appear to succeed without attending to it.

So far as the opinion of the writer of this article is of any value, it is rather in favour of the system of resting these plants for three or four months annually by lowering the temperature to 60° or thereabouts, and diminishing the moisture very considerably; indeed in regard to *Catasetum*, *Cycnoches*, *Phaius*, *Bletia*, *Geodorum*, and some others with deciduous leaves, there is no doubt that the plan is indispensable; and it would probably be equally advantageous with respect to all the kinds with fleshy stems or pseudo-bulbs; but how far it may suit caulescent species with the habit of *Vanda* and *Aerides* can only be ascertained by direct experiment.

EPISTILBITE, a Mineral occurring massive with attached crystals. The primary form is a right rhombic prism. The cleavage parallel to the short diagonal of the prism. Colour white. Streak white. Fracture uneven. Hardness 4·0 to 4·5. Lustre vitreous. Transparent, translucent. Specific gravity 2·20 to 2·25. It is found on Faroe Islands and in Iceland. The analysis of the Iceland mineral by Rose is as follows:—Silica, 58·59; alumina, 17·52; lime, 7·56; soda, 1·78; water, 14·98.

EPITHELIUM. As on the external surface of the animal body there is covering over all a delicate layer of cells which is called Epidermis, so over the internal surface of the body there is found a layer of cells which are called Epithelial Cells, or Epithelium. The epidermal and epithelial cells are homologues, and are so many modifications of a similar general arrangement.

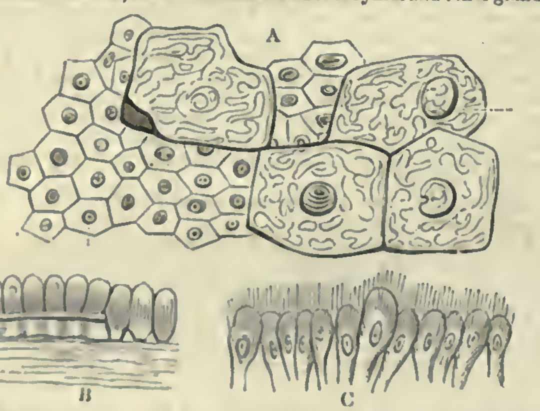
The functions of the epithelial cells vary according to the surfaces on which they are placed. They differ from the epidermal cells in being generally moist from the positions in which they are placed. The cells of the epithelium performing, as they do, the most remarkable part of the functions of the organs of which they form a part, vary much in form and size. In all cases they are soft, contain a nucleus, and are in shape rounded, polygonal, fusiform, or conical. Sometimes they occur in one layer, sometimes in several. In some instances they are supplied with cilia. The following is Kölliker's arrangement of the epithelial cells:—

a. Epithelium in a single Stratum.

1. With rounded polygonal cells. This, called Pavement Epithelium (*Fig.* A), presents only a single layer. It exists as an investment of the true serous membranes, of most synovial membranes, of the cerebral ventricles (ependyma), of the membrane of Demours, of the back of the iris, and of the inner surface of the choroid (pigment layer) of the capsule of the lens and of the retina, of the internal ear, of the endocardium of the veins, of many glandular vesicles and canals, and of the interlobular ducts of the liver.

2. With fusiform superficially united cells. This is called Fusiform Epithelium, and is found in the arteries and many veins.

3. With cylindrical cells. This is the Cylindrical Epithelium. (*Fig.* B.) It is found in the intestinal tubes in Lieberkühn's glands, in the excretory ducts of the gastric glands, as well as of all the other glands which open into the intestine, also of the lacteal and lachrymal and other glands.



4. With cylindrical or conical ciliated cells. This is the Ciliated Cylinder Epithelium. (*Fig.* C.) It is found on the finest bronchiæ, in the nasal cavities, on the inner surface of the membrana tympani, in the Eustachian tube, in the uterus, and in the Fallopian tubes.

5. With rounded ciliated cells. This is simple Ciliated Pavement Epithelium, and occurs in the cerebral cavity of the embryo.

b. Epithelium in many Layers.

1. With cylindrical or rounded cells below, rounded polygonal, more or less flattened cells above. This is called Laminated Pavement Epithelium. It occurs in the mouth, the lower half of the pharynx, the œsophagus, the lachrymal canals, the conjunctiva, the tympanic cavity, the bladder, the reproductive passages, the kidneys, and certain synovial membranes.

2. With rounded cells below, more elongated ones in the middle, and ciliated conical ones above. This is called Laminated Ciliary Epithelium. It occurs in the larynx, trachea, and larger bronchiæ, in the nasal cavity, in the lachrymal sac and duct, and the upper half of the pharynx.

In many instances these forms of Epithelium pass into each other, where they are placed upon the same surface.

The functions performed by the Epithelium are various. In the instances where the cells are supplied with cilia, their object seems to be to give movement to the fluids secreted upon their surfaces. [CILIA.] Those placed on mucous membranes elaborate the protective mucus which covers these organs. In the case of those cells which are prolonged into the follicles and tubuli of which glandular structure is essentially composed, they are the real organs of secretion. [SECRETION.] They separate from the blood, as the materials of their nutrition, the peculiar products elaborated by the gland of which they form a part, and by their death and decay these products are set free to perform their work in the system. Even the cells in which the spermatozoa are developed for the fertilisation of the ova are produced upon the surfaces of the tubes or follicles of the spermatic glands.

(Kölliker, *Manual of Human Histology*, translated by Busk and Huxley; Carpenter, *Principles of Physiology*.)

EPITHEMIA. [DIATOMACEÆ.]

EPOMIS. [CHLÆNIUS.]

EPOMOPHORUS. [CHEIROPTERA.]

EPSOMITE, Native Sulphate of Magnesia. It occurs massive, botryoidal, and reniform, on the surface of other bodies, and in solution in sea and mineral waters. Colour white. Streak white. Structure fibrous, sometimes earthy. Brittle. Taste bitter and saline. Found originally in a spring at Epsom. It forms a large bed near Arequipa in Peru, and is often in fine crystals and silky fibres.

EQUIDÆ, a family of Animals to which the Horse belongs. They have but a single finger or toe terminating each extremity; and this finger or toe is incased in a horny-hoof, or shoe. But though the *Equidæ* possess but one well-developed toe, there are on each side of the metacarpus and metatarsus two small rudimentary processes which represent two lateral toes. The following is the form of dentition:—

$$\text{Incisors, } \frac{6}{6}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{7-7}{6-6} = 42.$$

Various fabulous species of these animals are recorded in the descriptions and figures of some authors; such as the Bisulcated Horse with a mane extending the whole length of the animal from head to tail, and figured by Jonston as the Æthiopisch Pferd (*Equus Æthiopicus*). The Wald-Esel is figured by the same author with a unicorn-like horn in the midst of its forehead. These may be classed with the figures of monstrous horses collected by Aldrovandus, a horse with a human head and face for example, and another with hands by way of anterior extremities, which as he says, according to Suetonius, belonged to Julius Cæsar, and would suffer no one else to mount him:—"Caius Julius Cæsar utebatur equo insigni pedibus prope humanis, et in modum digitorum ungulis fissis," &c. This last was probably a case of malformation of the hoof; but the painter has given the animal two human hands, with four fingers and a thumb on each, and nails to match.

Linnæus, in his last edition of the 'Systema Naturæ' (12th), left the Horse (*Equus*) among his *Belluæ* (the sixth order of *Mammalia* in his arrangement), in company with the genera *Hippopotamus*, *Sus*, and *Rhinoceros*. His genus *Equus* consists of the following species: *E. Caballus*, *E. Asinus*, and *E. Zebra*, and is thus defined by him:—Incisor teeth (dentes primores) six above erecto-parallel, six below more prominent; canines (laniarii) solitary, included, remote on each side. Feet with an undivided hoof.

Gmelin, in his edition of the 'Systema Naturæ' (13th), added to the above definition, 'Teats two, inguinal,' and divided the genus into two sections—1, species with bisulcated feet; 2, species with solidungulous feet. The first section consists of one species only, *E. bisculus*, the 'Equus pedibus bisulcis,' Molin., 'Hist. Nat. Chil.' This was most probably a Llama. The second section embraces the following species:—*Equus Caballus*, *E. Hemionus*, *E. Asinus*, *E. Zebra*, and *E. Quagga*.

Cuvier places the Solipèdes at the end of his Mammiferous Pachyderms, and makes this family to consist of only one genus, *Equus*, with the following species:—*Caballus*, *Hemionus*, *Asinus*, *Zebra*, *Quagga*, and *Montanus*.

Dr. Gray, in his 'Revision of the Family Equidæ' ('Zool. Journ.,' vol. i), observes that the older authors speak of the Horse, Mule, Onager, Ass, and Zebra, the last of which they generally describe as having the body (corpus) striped with black, brown, and white bands, three inches broad, but take no notice of the colour of its legs; but in Jonston's figure they are distinctly banded. After referring to the other figures in Jonston and to Molina's Guemel, or Huemul, *Equus bisulcus* of Gmelin, which, if it exists, Dr. Gray considers to be probably a species of Llama (*Auchenia*), he notices the figures in Edwards's 'Gleanings'—the species recorded by Linnæus, Pallas, and Burchell,—the Quagga sent by Captain Gordon from the Cape to Amsterdam, where it was first described and figured from his drawing in the Dutch edition of Buffon, and afterwards in the supplement of the French editions; and L'Ane Isabelle of Le Vaillant. With regard to the last, which is described as being of a plain Isabella colour without any band, Dr. Gray observes, that nobody since Le

Vaillant's time, as far as he can learn, has mentioned it, and he asks whether it may not be an albino variety of the Zebra or Quagga, as the ass is sometimes found of yellowish-white, without any cross, in its domesticated state.

Dr. Gray thus defines the family of *Equidæ*:—"This family (which is distinguished from all other animals by its undivided hoof, formed of the two anterior toes soldered together, its simple stomach, and its female having the teat placed on the pubes) may be divided into two very distinct types of form; the one, the Asses and the Zebras, which are always whitish and more or less banded with blackish-brown, and always have a distinct dorsal line, the tail only bristly at the end, and have warts only on the arms and none on the hind legs; and the true Horses which are not banded, have no dorsal line, are furnished with warts on their arms and legs, and have long hair on the tail, from its insertion to its extremity." He further proceeds with his definition thus: "*Equidæ; Solidungulæ* Antiquorum, Cuvier, &c. Genus *Equus*, Linnæus:—

Dentes incisores, $\frac{6}{6}$; canine (mares), $\frac{1-1}{1-1}$; molars, $\frac{6-6}{6-6} = 40$.

Pedes ungulâ indivisâ." Dr. Gray then divides the family into two genera, namely: 1. *Equus*, consisting of the Common Horse and its varieties, *Equus Caballus*; 2. *Asinus*, embracing the following species: 1. *E. Hemionus*; 2. *E. vulgaris* (and its varieties); 3. *E. Quagga*; 4. *E. Burchellii*; 5. *E. Zebra*.

M. Lesson states that the Solipèdes, or *Equidæ*, of Gray, comprise only the genus *Equus*, which Dr. Gray has proposed to advance to the rank of a family under that name, comprising the genera *Equus* and *Asinus*; but, adds M. Lesson, there is nothing to induce us to admit a division which reposes only on superficial characters.

Mr. Bell is of a different opinion, and in his 'British Quadrupeds' follows Dr. Gray in considering the Ass as belonging to a distinct genus from the Horse, and he adopts Dr. Gray's family-name *Equidæ*. Mr. Bell makes the following remarks on the character of the Ass and its nearest congeners as compared with those of the Horse, upon which it had been thought necessary to establish them as distinct genera in the family. After admitting the truth of the observation that, in the absence of any knowledge of the original condition of the Horse, the question can only be considered with reference to the characters of a domesticated and probably much altered race, he reminds the reader, nevertheless, that as the distinctions upon which the division in question is founded are structural, there is less danger of error than if they had been only those of colour or of general form, and thus proceeds: "The character of the tail is one of the most striking points upon which this distinction rests. In the horse, the whole of this part is covered with long hair, totally concealing its actual form; whilst in the whole of the others, the ass, the zebra, the quagga, the dzigtai, &c., it is only clothed with long hair towards the extremity. The mane of the horse also is long and flowing; that of all the other species is short and upright. In the former animal, the hinder as well as the fore legs are furnished with those warty collosities, which in the others, without exception, are found only on the fore legs. Waiving some other particulars of minor importance, there is one character which, if not in itself to be considered of primary value, is yet interesting, and not unimportant as a collateral distinction: I mean the general tendency of the coloration and marking in the two forms. In the horse's coat there is an obvious disposition to the formation of small round spots of a different shade or hue from that of the ground, and this is the case whether the general colour be black, chestnut, or gray; in the genus *Asinus*, on the contrary, the markings are invariably disposed in stripes. The zebra, the quagga, and the mountain zebra are examples too familiar to require more than this allusion; and in the common ass, not only is the same tendency evinced by the cross-mark on the shoulders, but in the young ass there are frequently observed some obscure darkish bands on the legs. These tendencies to a peculiar character of coloration and marking are well worthy of especial notice in the *Mammalia*, among which will be found numerous instances bearing upon the distinction of approximating forms. In birds and insects it is still more general and striking, and has always attracted the attention of naturalists; but in the present class it has certainly been too much overlooked."

Geographical Distribution of the *Equidæ*.—Although the Horse, the Ass, and the Mule, are now spread over the whole face of the civilised earth, and although the Horse is found wild, or rather has reverted to a wild state, in both the New and the Old World, there can be no doubt that the form which we are now considering was originally entirely confined to the latter portion of the globe, where the truly wild species of the family, the Zebra, the Quagga, &c. are still to be found in all their native freedom. And this leads us to consider the time and the place where the Horse was first subdued by the powerful hand of man. Mr. Bell, who appeals to the sacred scriptures in proof that the Horse is of eastern origin, is of opinion, from the same authority, that the Egyptians were probably the first who broke the proud spirit of this noble animal, and reduced it to obedience and servitude. The books of Genesis and Exodus abound with passages which prove that the Horse had been long under the dominion of man at the date of the events then recorded. It was expressly prohibited (Deut., xvii. 16) that the king should multiply horses to himself, or should cause the people to return to Egypt, to the end that he should multiply horses. Solomon however does not seem to have regarded this prohibition, for his stables were filled with these noble animals; he had 40,000 stalls of horses for his chariots, and 12,000 horsemen. (1 Kings, iv. 26.)

The grand description in Job (xxxix. 19-25) is familiar to most, but Egypt (1 Kings, x. 28), and not Arabia, seems to have been the source whence Solomon's supplies were obtained. In very early Egyptian monuments the horse is seen in battle, and under circumstances which denote long subjugation and experienced training.

It seems to be quite clear that the wild horses of Tartary are as much the descendants of a domesticated race as the wild horses of America, whose ancestors were introduced by the Spaniards; nor have we any evidence to show the time when the horse existed in a primitive state of nature.

The *Equidæ* form two genera—*Equus* and *Asinus*; the species however freely breed together in confinement, but the produce is almost always, if not always, barren.

Equus has the tail covered with long hair to the base, the fore and hind legs with a wart (sallenders) on the inner side. The fur is dappled, that is, marked with round pale spots, having a dark net-like ground.

E. Caballus, the Horse, is brown, gray, or black, with roundish pale spots.

The following are the synonyms and varieties of this species given by Dr. Gray in the 'Catalogue of the British Museum:'—*Equus antiquorum* (Gesner). *Equus Caballus* (Linnæus; F. Cuvier; Fischer; Gray). *Equus, Equa* (Pliny). Horse (Pennant). Generous Horse (Pennant). Cheval (Buffon; Cuvier). Pferd (Redinger). Ross (Schrank). The Horse (Youatt). The Tarpan Wild Horse, primeval bay stock (H. Smith). The Andalusian Horse (H. Smith). South American Horse (H. Smith). The Parameros of Peru (H. Smith). Mexican Horse and Seminole Horse (H. Smith). Feral Horses of America (H. Smith). The Arabian Horse (Bewick; Low; Smith). The Race-Horse (Bewick; Low). English Race-Horse (Smith). Hunter (Bewick). The Old Irish Hunter (Low). The Connamara Horse (Low). Black Horse (Bewick). The Old English Black Horse (Low). The Cleveland Bay Horse (Low). The Suffolk Punch (Low). The Clydesdale Breed (Low). Old English Road-Horse (Bewick). Common Cart-Horse (Bewick). Improved Cart-Horse (Bewick). The Barb of Morocco (H. Smith). The Bornou (white) Race of Africa (H. Smith). The Dongola (black) Race (H. Smith). The Turkish Race (H. Smith). The Persian Race (H. Smith). The Toorkee Races (H. Smith). The East Indian Races (H. Smith). The New Holland Horse (H. Smith). The Transylvanian Horse (H. Smith). The Moldavian Horse (H. Smith). The Greek Horse (H. Smith). The Spanish Horse (H. Smith). Cheval d'Islande—var., *Islandicus* (Quoy and Gaim.; Lesson). *Equus Mongolicus* (Lesson). Thibet Horse (Hodgson). Cheval à Port Frisses—*E. frisius* (F. Cuvier). *Equus Caballus frisius* (Lesson). Villous Horse—primeval of the white stock (H. Smith). The White or Gray Horse (H. Smith); Marengo,—'Bonaparte's Arab.' The Crisp-Haired Horse—primeval of the black stock (H. Smith). The Black Horse—the English Draught-Horse (H. Smith). The Dun or Tau Horse (H. Smith). The Decussated Horse, or the Eelback Dun Horse of Ukraine (H. Smith). The Myautzee, or the Pied Horse of China (H. Smith). The Bhooteahs Ponies (H. Smith). The Pickarrow Ponies (H. Smith). The Yaboos of Affghanistan Ponies (H. Smith). The Hungarian Horse, with slit nostrils (H. Smith). The Common Bashkir Horse (H. Smith). The Morea Ponies (H. Smith). The Swedish and Norwegian Ponies (H. Smith). The Shetland Ponies (H. Smith). The Galloway (H. Smith). The Dartmoor and Exmoor Pony (H. Smith). Sardinian Wild Horse (H. Smith). The Tatto, or the East Indian Pony (H. Smith). Tuttoo, or Mahratta Pony (Sykes); sedulously propagated in the Deccan: much used to transport luggage, and very vicious.—Sykes. Tattoo, or Hack Pony of Calcutta (Hardwick). The Taugum Piebald or Skewbald Horse—*Equus varius* (H. Smith). The Tangum, or Tanghans—primeval Piebald Stock of Thibet (H. Smith). Skewbald of Achin in Sumatra (H. Smith). Tangham of China (Hodgson). Tangham of Lhassa (Hodgson). Tangham of Gyanche (Hodgson). Hubstee of Deo Dharma (Hodgson). The Koomrah, or *Equus hippargus* (H. Smith). The Koomrah—*Equus Lalisi* (H. Smith). Hippargus (Oppian). Boryes (Herodotus). Bourra of Koldagi (Rüppell); Northern Africa: not gregarious. The Kuda or Saran Horse (H. Smith). The Javan Horse (H. Smith). The Tamboro or Birma Horse (H. Smith). Horse with a curled moustache on the upper lip, of Asiatic Russia (Pallas). Horse covered with curled woolly hair, of Asiatic Russia (Falk.; Pallas). Naked Horse of a beautiful form, of Asiatic Russia (Pallas). The Argamaki of Bocharia—a white horse with very close, minute, orbicular, brown spots, of Asiatic Russia (Pallas).

It is questionable as to whether there exist at the present day any truly wild horses or descendants of an originally wild stock. Dr. Gray observes that the figure of the Wild Horse, as given by Gmelin, very much resembles the ponies left at liberty on the commons of Cornwall and mountains of Scotland; and it appears very doubtful if these animals are not rather to be considered as domestic horses which have escaped and become deteriorated. This is not the case with the wild horses which are found on the rich prairies of America, which retain the size and form of the well-bred horse. In many parts of the world the Horse is found in a semi-wild condition. It was introduced by the French into the Falkland Islands in 1764, and since that time they have greatly increased. The horses in these islands are always found on the eastern side of East Falkland, although there is no natural boundary; and that part of the island is not more fertile than the rest. The predominant colours of these horses are roan and iron-gray. Mr. Darwin says they are rather small-sized, but are generally in good condition. In South America the Horse was first landed at Buenos Ayres in 1537, and the colony being for a time deserted, it ran wild. In 1580, forty-three years after, they were found wild at the Straits of Magellan. On the Pampas they now abound in prodigious numbers. The Guachos, a semi-civilised race of men, live amidst these horses. They early learn to capture and ride them, and a Guacho is seldom off the back of his horse. It is said that they can capture and break in one of these wild horses in the course of an hour. The flesh serves them also as an article of food. The hides are preserved and sold. With the horses are also herds of wild oxen. The numbers of these animals may be judged of from the fact that in a period of five years, from 1838 to 1842, Monte Video and Buenos Ayres yielded annually about 90,000,000 lbs. of oxen and horses' hides, and 9,500,000 lbs. of horse-hair. The Horse is now found over the whole continent of America. Darwin says the natives of Tierra del Fuego are well stocked with horses, each man having six or seven, and all the women and even the children have their own horse. In his 'Fauna Boreali-Americana,' Sir John Richardson tells us that the Horse is found amongst the wandering Indians who frequent the prairies of the Saskatchewan and the Missouri. They use it for chasing the buffalo, as well as a beast of burden. Amongst the Indians, as well as the Guachos, the Horse is eaten. It is also eaten by the Calmuck Tartars, and in many parts of Asia mare's-milk is taken as an article of diet. It is also converted into butter and cheese, and a favourite beverage amongst the Tartars is made by fermenting it.

Everywhere the horse is recognised as the most useful of the servants of man, and he yields in intelligence to the dog alone. In the earlier ages of the world he seems to have been devoted to the purposes of war or of pleasure, while the ox was our agricultural servant; but his beauty, and strength, and tractability have now connected him, directly or indirectly, with almost all the purposes of life. If he differs in different countries in form and in size it is from the influence of climate and cultivation; but otherwise, from the war-horse, as he is depicted on the friezes of ancient temples, to the stately charger of Holstein and of Spain, or from the fleet and beautiful Arabian to the diminutive Shetlander, there is an evident similarity of form and destination which clearly stamps his common origin.

He is naturally and of choice an herbivorous animal. His thin and muscular lips, his firm and compressed mouth, and his sharp incisor teeth are admirably adapted to seize and to crop the grass; and although we know nothing of him in his natural state, yet when he has escaped from the bondage of man, and follows his own propensities, the grass is his chosen food. In his domesticated state however he was destined to live partially or chiefly on other aliment, and that of a much harder kind—the various species of corn; therefore while man and the carnivorous animals can only champ and crush their food, a provision is given to the horse, in the structure of some of the bones of the face, by means of which he can comminute and grind down his food as perfectly as in the best contrived mill.

The teeth of the horse require some lengthened consideration, not only from their admirable adaptation to this purpose, but as indicating, by the various changes which they undergo, almost beyond the possibility of error, the age of the animal. He may, when young in years, be reduced nearly to the decrepitude of age by the barbarous usage of those who ought to be his most zealous protectors; the cavity above the eye may be deepened, the under lip may fall, the limbs may be bowed, and the feet may be battered and distorted,—but it is not easy to alter the character of the teeth.

The colt is generally dropped with the first and second molar and grinding teeth having forced their way through the gum. When he is about seven or eight days old the two central front or incisor teeth, above and below, appear. At the expiration of five or six weeks the next two incisors may be seen. At three months they will have overtaken the central ones, and both pairs will have nearly attained their natural level. A third grinder will then have appeared; and a little before or after the eighth month the third nipper, above and below and on each side, will be seen. The colt will now have his full complement of front or cutting teeth.

These teeth are beautifully adapted to their purpose. They have in front an elevated cutting edge of considerable sharpness. It is formed of enamel, a polished substance almost too hard to be acted upon by the file, which covers the tooth. This elevated edge is bent somewhat inwards and over the tooth, so that there is a depression behind it which gradually becomes stained by the food and constitutes what is called 'the mark' in the mouth of the colt or horse.

This elevated edge of enamel, hard as it is, is gradually worn down in the act of nipping and cutting the grass; and as it wears away the hollow behind becomes diminished, and is at length totally obliterated. By the degree in which this mark is effaced, the horseman, not only with regard to the first, but the permanent teeth, judges of the age of the animal. This obliteration begins to be manifest at a very early age. At six months it is sufficiently evident in the four central nippers. At a year and a half the mark will be very faint in the central nippers, diminished in the other two, and the surface of all of them will be flattened.

At twelve months a fourth grinder protrudes, and a fifth at the expiration of two years.

These are all temporary teeth. They were only to last during a very early period of the life of the animal; and when his jaws were considerably expanded they were destined to give way to another set, larger, firmer, and that would probably last during life. The permanent teeth had been long growing in the socket beneath the temporary ones, and had been pressing upon their roots, and that pressure had caused an absorption of these roots, until at length they lost all hold and were displaced.

When the animal is about three years old the central pair of nippers, above and below, are thus removed, and two fresh teeth, easily distinguishable from the first by their increased size, make their appearance, so that a three-year-old colt is easily recognised by these two new and enlarged central nippers.

A three-year-old colt has his form and energies much more developed than a two-year-old one, and is considerably more valuable; therefore some dishonest breeders endeavour to pass him upon the unwary as being a year older than he really is, and they accomplish this in an ingenious but cruel manner. This cannot however be effected until a portion of the second year is past, when the permanent teeth below are beginning to press upon the roots of their predecessors, and then the breeder extracts the central milk-teeth. Those below having no longer anything to resist their progress, grow far more rapidly than they otherwise would do, and the scoundrel gains four or five months in the apparent age of his colt.

Can this trickery be detected? Not always, except by him who is well accustomed to horses. The comparatively slow wasting of the other nippers, the difference of the development of these nippers in the upper and under jaw—for the breeder usually confines his roguery to the lower jaw, the upper one being comparatively seldom examined—these circumstances, together with a deficiency of general development in the colt, will alone enable the purchaser to detect the attempted cheat.

The honest mouth of a three-year-old horse should be thus formed: —the central teeth are palpably larger than the others, and have the mark on their upper surface evident and well defined. They will however be lower than the other teeth. The mark in the next pair of nippers will be nearly worn away, and that in the corner nippers will begin to wear.

At three years and a half the second nippers will be pushed from their sockets, and their place gradually supplied by a new pair; and at four and a half the corner nippers will be undergoing the same process. Thus at four years old the central nippers will be fully grown; the next pair will be up, but will not have attained their full height; and the corner nippers will be small, with their mark nearly effaced. At five years old the mark will begin to be effaced from the central teeth, the next pair will be fully grown and the blackness of the mark a little taken off, and the corner pair will be protruding or partly grown.

At this period, or between the fourth and fifth year, another change will have taken place in the mouth; the tushes will have begun to appear. There will be two of them in each jaw, between the nippers and the grinders, considerably nearer to the former than the latter, and particularly so in the lower jaw. The use of these tushes in the domesticated state of the horse is not evident; but they were probably designed as weapons of offence in the wild state of the animal. Attempts are too frequently made to hasten the appearance of the second and the corner teeth in the same manner as described with regard to the first, and the gum is often deeply lanced in order to hasten the appearance of the tush.

At six years old the mark on the central nippers will be diminished, if not obliterated. A depression and a mark of rather brown hue may remain, but the deep blackened hole in the centre will no longer be found. The other incisors will also be somewhat worn, and the tush fully developed.

At seven the mark on the next pair of incisors will have nearly disappeared, and the tush will be rounded at the point and the edges.

At eight the mark will have disappeared from all the incisor teeth, and the tush will be evidently rounder and blunter.

At this period another piece of trickery is occasionally practised. The breeder had, till the animal was five years old, been endeavouring to give him an older appearance than his years entitled him to, because in proportion as he approached the period when his powers were most perfectly developed his value increased; but now he endeavours to conceal the ravages of age. The horse is cast, and with a sharp-pointed steel instrument a little hole is dug on the surface of the corner incisor, to which a red-hot iron is afterwards applied. An indelible black mark is thus left on the tooth. Sometimes the roguery is carried further; the next tooth is slightly touched with the engraver and the cautery; but here the dishonest dealer generally overreaches himself, for the form and general appearance of a six-year-old horse can rarely be given to one who has passed his eighth year. The eighth year having passed, it is difficult to decide on the exact age of the horse. The incisors of the upper jaw are then the best guides. At nine years the mark is said to be worn away from the central teeth; at eleven, from the next pair; and at twelve, from the corner ones. The tush likewise becomes shorter and blunter.

There are many circumstances which render a decision as to the age of the horse very difficult after the marks are effaced from the lower incisors, and even before that period. Horses always kept in the stable have the mark much sooner worn out than those that are at grass, and it is impossible to form any calculation at all as to crib-biters.

Of the age to which the horse would naturally arrive it is impossible to say anything satisfactory. Many have exceeded thirty, and some of them even forty years; but, from ill usage and over exertion, the majority come to their end before they have seen nine or ten years.

The Proper Conformation of the Horse.—A very general account only can be given of this, for it varies essentially with the breed and destination of the animal. There are some points however which are valuable in horses of every description. The head should not be disproportially large, and should be well set on, that is, the lower jawbones should be sufficiently far apart to enable the head to form that angle with the neck which gives free motion and a graceful carriage to it, and prevents its bearing too heavily on the hand. The eye should be large and a little prominent, and the eyelid fine and thin. The ear should be small and erect, and quick in motion. The lop-ear indicates dulness or stubborness; and when it is habitually laid too far back upon the neck, there is too frequently a disposition to mischief. The nostril in every breed should be somewhat expanded: it can hardly be too much so in the Racer, the Hunter, the Roadster, and the Coach-Horse, for these animals breathe only through the nostril, and would be dangerously distressed when much speed is required of them, if the nostril could not dilate to admit and to return the air. The neck should be long rather than short. It then enables the animal to graze with more ease, and to throw his weight more forward, whether he is in harness or galloping at the top of his speed. It should be muscular at its base, and gradually become fine as it approaches the head. The withers should be somewhat high in every horse, except perhaps that of heavy draught, and it does not harm him, for there is larger surface for the attachment of the muscles of the back, and they act at greater mechanical advantage. A slanting direction of the shoulder gives also much mechanical advantage, as well as an easy and pleasant action, and a greater degree of safety. It must not however exist in any considerable degree in the horse of draught, and particularly of heavy draught. The chest must be capacious, for it contains the heart and the lungs, the organs on which the speed and endurance of the horse depend. Capacity of chest is indispensable in every horse; but the form of the chest admits of variation. In the Waggon-Horse the circular chest may be admitted, because he seldom goes at any great speed, and there is comparatively little variation in the quantity of air required; but in other horses the variation is often fearful. The quantity of air expended in the gallop is many times that required in hard work. Here we must have depth of chest, not only as giving more room for the insertion of the muscles on the action of which the expansion of the chest depends, but a conformation of the chest which admits of that expansion. That which is somewhat straight may be easily bent into a circle when greater capacity is required; that which is already circular admits of no expansion. A few words more are all that our limits permit us to add, and they contain almost all that is necessary to be added on the conformation of the Horse:—"The loins should be broad, the quarters long, the thighs muscular, and the hocks well bent and well under the horse."

General Management of the Horse.—The foal, as soon as it is dropped, should be turned with its dam into a sheltered and good pasture, in which there is a hovel for occasional retreat from the wind and rain. Some hay or corn, or both, should be allowed, if it is early in the season, or the grass has scarcely begun to shoot. There is nothing so detrimental to the colt as insufficient food. It should be regarded as a fundamental principle in breeding, that if the growth is checked by starvation, beauty and energy and stoutness will rarely be displayed in after-years.

In five or six months, according to the growth of the foal or the convenience of the farmer, the weaning may take place. The colt should be removed from his former haunts to some distant rick-yard, or confined to a stable until he becomes a little reconciled to the loss of his dam.

In the ensuing spring the breaking may commence; a process on which will materially depend the temper and value of the horse, and the pleasure of the rider. The foal should be handled and haltered, and led about by the servant who has the chief care of him, and whose conduct towards him should always be kind. "The principle," says the author of 'The Horse,' "on which the after-usefulness of the animal is founded, is early attachment to and confidence in man, and obedience, resulting principally from these."

With regard to the Racing Colt, the processes of breaking and training are injuriously and cruelly completed in the second year, and thousands of horses are irreparably injured by this early exaction of labour and speed; but in the Hunter, the Hackney, the Agricultural and the Carriage-Horse, the serious part of this business is not entered upon until the third year.

A horse is well broken when he has been taught implicit and cheerful obedience to his rider or driver, and dexterity in the performance of his work. A dogged, sullen, spiritless submission may be enforced by the cruel and brutal usage to which the breaker so frequently has recourse; but that prompt and eager response to the slightest intimation of the rider's will—that manifest aim to anticipate every wish, that gives to the horse so much of his value—must be built on habitual confidence and attachment. The education of the horse should be that of the child. Pleasure should be as much as possible associated with the early lessons; while firmness, or, if need be, coercion must establish the habit of obedience.

The breaking being accomplished, the management of the Horse will vary according to his breed and destination; but the good usage of our domesticated slaves should be regarded as a principle that ought never to be violated. The Agricultural Horse is seldom overworked, and on large farms is generally well fed; perhaps in many cases too much above his work. This however is an error on the right side. A very slight inspection of the animal will always enable the owner to determine whether he is too well or not sufficiently fed. The size of the horse, and the nature of the work, and the season of the year, will make considerable difference in the quantity and the quality of the food. The following accounts will sufficiently elucidate the general custom:—"Mr. Harper, of Bank Hall, Lancashire, ploughs seven acres per week, the year through, on strong land with a team of three horses, and allows to each weekly two bushels of oats, with hay, during the winter six months, and during the remainder of the year one bushel of oats per week, with green food. Mr. Ellman, of Glynde in Sussex, allows two bushels of oats, with peas-haulm or straw, with but very little hay, during thirty winter weeks. He gives one bushel of oats, with green food, during the summer."* There is very little difference in the management of these two gentlemen, and that probably arising from circumstances peculiar to their respective farms. The grand principles of feeding with reference to agricultural horses are, to keep the animal rather above his work, to give him good and wholesome food, and, by the use of the nose-bag or other means, never to let him be worked more than four or five hours without being baited.

The horse of quick work, the Stage-Coach Horse and the Poster, should be allowed as much as he will eat, care being taken that no more is put in the manger than he will readily dispose of. The quantity actually eaten will depend on the degree of work and the natural appetite of the horse, but it may be averaged at about 66lbs. of chaff, 17½lbs. of beans, and 77lbs. of oats per week. When the work is unusually hard, the quantity of oats may be diminished, that of beans increased, and a portion of barley added.

During the sporting season the Hunter is well fed, and with that kind of food which contains a great proportion of nutriment in little compass. A small quantity of hay, rarely more than 8lbs. or 10lbs. per day, is allowed, and less than that on the day before work. The quantity of corn may vary from 14lbs. to 16lbs. daily. There is a prejudice in most hunting stables, and probably well founded, against chaff, and it is seldom that the beans and oats are bruised. A bran-mash is given after a day of more than usual fatigue, and is serviceable at other times, when there has not been more than ordinary work, provided that at least two days are suffered to elapse before the horse is again taken into the field.

No horse should be urged on after he has exhibited unequivocal symptoms of distress, such as a drooping pace, a staggering gait, a heavy bearing on the hand, a rapid inspiration like a hurried sigh, and a peculiar convulsive action of the diaphragm, as though the heart were violently beating against the side. The loss of blood, the administration of some cordial medicine, and slow leading to the nearest stable, are the best restoratives at the moment of distress; although the cordial would be absolutely destructive a few hours afterwards, when inflammation had commenced.

The hunting season having passed, the horse used to be turned into the field as soon as the grass had begun fairly to sprout, and there, with his feed or two feeds of corn daily, and his hovel, into which he might retreat from the sun or the storm, he remained until the middle of June, or the flies began to be troublesome. It was delightful to see how much he enjoyed this short period of liberty; and well had he earned it. Of late years however it has become the fashion to confine him to his box, whence he stirs not except for an hour's walking exercise on the road, until he is taken into training for the next winter's business.

Nothing can be so erroneous or cruel as this. There are few horses that have not materially suffered in their legs and feet before the close of the hunting season. There cannot be anything so refreshing to their feet as the damp coolness of the herbage which they tread at that period, and there is no physic which so safely and effectually as

* 'Agricultural Survey of Sussex,' pp. 378, 381.

the spring grass carries off every humour that may be lurking in their frame.

The training of the Hunter for his work is a simple affair. It is, by means of exercise and of physic, getting rid of all superfluous fat and flesh, without debilitating him. The physic is useful; it is indispensable; but the chief thing is gradually to accustom him to the exertion of every power that he possesses, without too much hurrying his breathing or overstraining or injuring him.

The training of the Race-Horse is of a similar character, but it is far more severe, for his strength, his speed, and his endurance must be tested to the utmost. The hunter has to carry his rider gallantly and well through perhaps a long burst, and if he tires, and the sportsman has the good sense and humanity to cease to urge him on, the greatest evil is some temporary suffering to him, and disappointment to his master; but if the race-horse breaks down, or if his capabilities have not been accurately calculated, the most serious loss may be sustained. Thence arises the necessity of straining and of testing every power in the preparation of the turf horse; and thence too it happens, from the strange and impolitic sacrifice of the endurance of the modern racer to speed during short distances, that so many young horses break down and become perfectly useless in their training.

The watering of the horse is a very important but disregarded portion of his general management. The kind of water has not been sufficiently considered. The difference between what is termed hard and soft water is a circumstance of general observation. The former contains certain saline principles which decompose some bodies, as in the curdling of soap, and prevent the solution of others, as in the making of tea, the boiling of vegetables, and the process of brewing. It is natural to suppose that these different kinds of water would produce somewhat different effects on the animal frame, and such is the fact. Hard water, freshly drawn from the well, will frequently roughen the coat of the horse unaccustomed to it, or cause griping pains, or materially lessen the animal's power of exertion. The racing and the hunting groom are perfectly aware of this; and so is the horse, for he will refuse the purest water from the well if he can obtain access to the running stream, or even the turbid pool. Where there is the power of choice the softer water should undoubtedly be preferred.

The temperature of the water is of far more consequence than its hardness. It will rarely harm if taken from the pond or the running stream, but its coldness when recently drawn from the well has often been injurious. It has produced colic, spasm, and even death. It should therefore be exposed for some hours, either in the stable or in some tank.

There is often considerable prejudice against the horse being fairly supplied with water. It is supposed to chill him; to injure his wind, or to incapacitate him for hard work. It certainly would do so, if, immediately after drinking his fill, he were galloped hard, but not if he were suffered to quench his thirst more frequently when at rest in the stable. The horse that has free access to water will not drink so much in the course of a day as another who, to cool his parched mouth, swallows as fast as he can, and knows not when to stop.

When on a journey a horse may with perfect safety be far more liberally supplied with water than he generally is. An hour before his work commences he should be permitted to drink a couple of quarts. A greater quantity might be probably objected to. He will perform his task far more pleasantly and effectively than with a parched mouth and tormenting thirst. The prejudice both of the hunting and the training groom on this point is cruel as well as injurious. The task or the journey being accomplished, and the horse having breathed a few minutes, another quart, or even two, will be delightfully refreshing to him, and will never do him harm. His corn may then be offered to him, which he will readily take; and before he has eaten the whole of it two or three more quarts of water may be given.

Towards the close of the day the speed of the traveller should somewhat abate, and the horse should arrive at his resting-place as dry and as cool as circumstances will permit. If he is hot he must be walked about awhile, or the perspiration will return in the stable. If he is wet he must be carefully rubbed dry. The sooner this is done the better; and after he is clothed, watered, fed, and bedded, he should as soon as possible be left to his repose.

In travelling the horse should undergo some degree of training as to the pace, the distance, and the burden. When there has been no preparation, the stages must at first be short, and the pace gentle. For a journey of 300 miles the horse may travel from 20 to 25 miles a day, resting on the Sunday, and doing the work in two stages, at the pace of six miles an hour. This requires a seasoned horse, and the number of working hours per day is about four.

Hunting requires speed and stoutness. The pace seldom exceeds twelve miles an hour, and the run is short, soon over, or interrupted; yet soft sinking ground, hills, and leaps make this pace severe even on the best horses. The time for preparation varies from two to four months. On the day before work the horse should have exercise enough to empty the bowels. If he is a good feeder he should have no hay within eight hours of starting, nor water within four hours, nor corn within three hours; but if he has five or six miles to go to cover, these restrictions are less necessary. The working days will vary according to his condition and the hardness of the running. He may be able to go out every second day, and sometimes not more than once in six or seven. His spirits and appetite, and the state of his legs, will decide this. Even on the blank days some exercise should be taken in order to evacuate the bowels and create an appetite.

Horses are best prepared for coaching by good feeding and gradual increase of speed and distance. The ordinary length of a stage is eight miles; so that a horse is required for every mile, or a coach running between two places forty miles distant, employs forty horses to take it away and bring it back. The pace being calculated at from nine to eleven miles an hour, no horse works quite an hour in the day, and some not more than three-quarters of an hour, except that, occasionally, an able horse may perform a double journey in order to relieve a sick companion. No horse therefore leads so easy a life as an English coach-horse in a well-regulated establishment. The muscular exertion is severe while it lasts, but it is soon over. The excitement however of high keep and excessive exertion gradually wears the horse down, and it is rarely that he continues in a fast coach more than four years. (Nimrod, 'On the Road.')

Cart-Horses usually work from eight to ten hours, six days in the week. The pace varies from two miles to three and a half miles per hour, and the weight rarely exceeds 24 cwt., besides the cart, which probably is seven or eight more. All beyond this in weight or in time of work is cruel.

The average work done by a horse in ploughing is about eight hours in the day. The severity of it depends on the pace, the nature of the soil, and the breadth of the furrow-slice. The pace is from a mile and a half to two miles per hour; the furrow varies from eight inches to eleven, and the distance travelled is from 12 to 16 miles. The horse and the man can well support this as long as the ploughing season continues.

Asinus.—The species of this genus have the upper part of the tail covered with short hair, and the lower part covered with longer hair forming a tuft; the fur marked with darker stripes; the fore legs only furnished with hard horny warts in a similar situation to those in the front legs of the horse, but there are none in the lower part of the hinder legs. We shall follow in our arrangement of the species that adopted by Dr. J. E. Gray in the 'British Museum Catalogue.'

* Colour nearly uniform, with a dark longitudinal dorsal stripe; some have a black stripe across the shoulders.—The Asses of Asia.

† Ears elongated, acute.—The Tame or Domestic Asses.

These animals vary greatly in size and appearance, according to the climate. They are large and smooth-haired in the warmer climates; small and shaggy in the colder countries.

It is very doubtful if the Domestic Ass is found in a truly wild state; the asses which have been described as wild appear rather to be domestic animals which have escaped, or mules between the Domestic Ass and the allied wild species; for when caught they, after a short time, submit themselves to man, which is not the case with what Dr. Gray has here considered as the wild kinds.

Pallas justly observes, "In extensis Asiæ desertis primam patriam esse quærendam *Equi feri* et *Onagri* a nomadibus in domesticos usus domatorum, æque ac Hemioni hactenus indomiti." ('Zool. Ross.,' A. i. 255.) This is equally applicable to the African species. [Ass.]

A. vulgaris, the Domestic Ass. Gray, with a longitudinal dorsal streak and a dark streak across the shoulders; ears elongate; facial line arched. Skull with suborbital foramen as in *E. Hemionus.*

The following are some of the synonyms of this animal:—

Equus Asinus (Linn.); *Asinus vulgaris* (Gray); *Equus Asina* (Fleming); *Asinus* (Plin.); Ass (Penn., Bewick); Asne (Buffon); Ane (Cuvier); *Asinus Onager* (Gray, Bonap. 'Index Mam. Eur.'); *Asinus domesticus*, Domestic Ass (H. Smith).

Var. Without any cross.

Var. Legs and body more or less banded.

Domestic Varieties.

Gudha of the Mahrattas, very little larger than a good mastiff or Newfoundland dog (Sykes). Domestic Ass of Ispahan (H. Smith). Domestic Ass of Beloochistan (H. Smith). Domestic Ass of Tibet, with a cross-band (Strachey). The Pico of ancient Egypt (H. Smith). Tasandunt of the Shelluhs (H. Smith). The Djaar of Arabia (H. Smith). The Lalisiones, or Wild Ass Colts (H. Smith). Lalisio (Martial). Wild Ass (Lenant; Hoskins). Egyptian Ass (H. Smith).

The common Domestic Ass is sometimes of the usual gray colour, without any appearance of the cross. They are sometimes black, and at other times white, rarely skewbald; but this is the common albinism and melanism of domestic animals, and when of these colours the cross is not apparent, or at least sometimes only to be seen when the animal is observed obliquely.

†† Ears moderately short, rounded.—The Wild Asses.

A. Onager, the Koulan, or Wild Ass. Pale reddish (in winter grayish); dorsal streak black, rather wider over the small of the back. Skull with the infraorbital foramen high up, about one-third the space between the face-line and the back edge of the teeth, far back, being directly over the front end of the cheek ridge and the back edge of the third grinder.

This species is the *Asinus sylvestris* (Plin.); *Onager* (Plin.); *E. Asinus Onager* (Schreb.); *Equus Onager* (Brisson); Wild Ass (Bell, Heber); Koulan, or Wild Ass (Penn.); *Equus Hemionus*, Wild Ass of Kutch and the Indus (Sykes); *Asinus Hemionus* (Gray); *Equus Khur*, Ane Khur (Lesson); Wild Ass, or Gour (Ker Porter); Wild Ass, or Khur, of the Persians; *Onager* (Xenophon); Hemione, or Dziggtai (Lesson); Hymar, or Hamar of Mesopotamia (H. Smith); *Asinus Hamar*, the Hamar (H. Smith); Chamor of the Hebrews.

This species inhabits the plains of Mesopotamia, Persia, Kutch; shores of the Indus, Panjab.

Mr. Layard says they are abundant in Mesopotamia, and are evidently the Wild Ass of Xenophon. The adults are very difficult to approach within rifle range. The young are sometimes caught alive.

The *Khur* inhabits the deserts of Persia in troops, frequenting the hills in summer and the plains in winter.

Pallas, in a paper entitled 'Observations sur l'Asne dans son État sauvage, ou sur le véritable Onagre des Anciens' ('Act. Acad. Sci. Imp. Petrop.,' 1777, 258. t. 11), figured a Wild Ass which was sent by sea from Derbent to Astrakhan. The figure greatly resembles the mule between the Hemione and the Ass now in the Zoological Gardens, but the ears appear a trifle longer. It is coloured in the same manner as the Hemione; that is to say, the more prominent parts of the body are dark, and the middle of the back, the front of the haunches and thigh, and the under part of the body are paler. The figure represents but a very indistinct cross-band on the shoulder.

This paper is translated into German, and a copy of the plates with a second figure of the back of the animal is given in Pallas, 'N. Nord. Beytr.,' ii. 22, t. 2; but in this figure the cross-band on the shoulders is not marked. From this description it would appear that the animal which is called the Wild Ass is not always marked with the cross-band on the shoulder which is so permanent in the domestic kind, and has hitherto been considered as its specific character.

The chief difference between Pallas's figure of the Wild Ass and the Hemione is the greater length and more acute form of the ears; of the latter the mule varies in this character.

Bishop Heber, as quoted by Colonel H. Smith, says, "No attempt has been made to break the Wild Ass (of Rajpootana) in for riding, nor did it appear that the natives ever thought of such.

"The Wild Ass of Cutch has the cross-stripe on the shoulder, and differs in colours and heavier proportion from the Wild Ass of Ker Porter."

Colonel Smith confounds the domesticated Gudha with the Wild Ass of the Deccan described by Colonel Sykes, and states on the colonel's authority that "it is not larger than a mastiff."

Eversmann says that many specimens of the Kulan, or *Equus Onager* of Pallas, have been brought to Orenburg from the high steppes between the Caspian and the Aral seas. A good specimen and a skull are in the Museum of the University of Kasan.

All these specimens are without the cross-band, and have only the longitudinal dorsal streak. Eversmann considers that the cross-band is either not the character of the species, or perhaps a sexual mark, as he observes that he is not able to discover the specific character which separates the *E. Hemionus* from the *E. Onager*. He further observes that the Mongolians have no particular name for the *E. Onager* of Pallas; the Tartars no name for *E. Hemionus*; the Mongolians called the *E. Hemionus* Dshiggetei, or more properly Tschikitei, meaning long ears, and the Tartars call the *E. Onager* Kulan.

Eversmann remarks that Pallas ('N. Nord. Beytr.,' ii. 34) states that the male M. Hablizl brought from Persia had no cross, but that the female which was shot on the Murecy had one. He proceeds to calculate the length of the ears of these animals, compared with the other measurements of them, and he finds that the ears of the male appear to be considerably (near two inches) shorter in proportion than the ears of the female. ('Bull. Soc. Imp. Nat. Mosc.,' 1840, 57.)

The Mule with *Asinus domesticus* has the short smooth fur exactly like the sire, but with a short narrow cross-band on the shoulder; the ears rather longer and black-tipped.

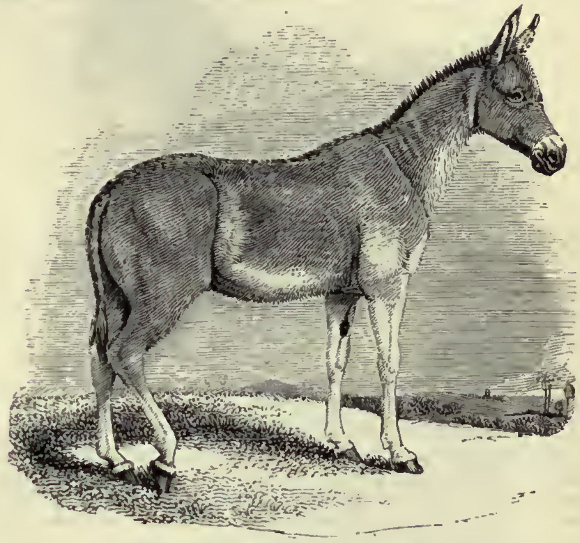
A. Hemionus, the Kiang. Fur short, smooth, bright-red bay. Legs straw-colour (in winter long, rather woolly, grayish, legs whitish), with a broad longitudinal dorsal streak, broadest over the small of the back, without any cross-band on shoulders. Skull: the infraorbital foramen low down, in the centre of the space between the face-line and the base of the teeth, and placed in a line over the back edge of the second grinder, some distance in front of the end of the cheek-ridge.

It is the *Mulus Dauricus fœcundus* (Messerschm, MSS.); *Equus Hemionus* (Pallas); *Equus Hemionus*, Kiang (Ogilby); *Equus Hemionos* (Bodd.); *Asinus Hemionus* (Gray); *Equus Onager* (Eversmann); (?) *Asinus Onager*, Onager Koulan, or Wild Ass of Tartary (H. Smith); *Asinus Equioides* (Hodgson, Blyth); Wild Ass (Moorcroft); *Equus Kiang* (Moorcroft); *Equus varius*, part. (H. Smith); *Asinus polyodon* (Hodgson); Jikta (Shaw); Dshikketee (Penn.); Dgiggetai (Cuvier); Dzigethai (Buffon); Wild Mule, Half Ass, or Fecund Mule (Penn.); Wild Ass ('English in Tibet'); Hemionos (Plin.); L'Hemione ('Ency. Méthod.'); the Ghoor, or Khur (Moorcroft, H. Smith); Wild Esol (Eversmann); the Kiang (H. Smith); Wild Horse (Gerrard).

It is found in Tibet.

This animal must not be confounded with the domestic asses which are used for burden in Tibet.

The male Kiangs are larger and deeper coloured. They live in troops of from eight to ten under the care of a solitary male, where the thermometer is below zero. They live partly on the plains and partly on the mountains; and the lower surface of the hoof varies considerably in form and concavity, perhaps from that circumstance.



Dshikketee, or Wild Ass (*Asinus Hemionus*).

The Ghoor or Khur of Ludakh, according to Moorcroft, is white about the nose and under the neck, the belly and legs; the back is light bay and the mane dun. They herd in droves, fly at a trot, stop, and look back.

Moorcroft saw the Kiangs on the highest summits of Tibet, in their shining summer coats and with their antelope form, scouring along in numbers.

Dr. Walker observes—The Kiang neighs like a horse. The Wild Ass of Cutch brays like an ass. The Kiang has no zebra stripes, neither in the adult nor in the foal. The Wild Ass of Cutch: transverse zebra stripes are seen on the shoulder in the adult, and still more in the foal; sometimes also the shoulder-cross has been seen. The habitat of the Kiang is on the high table-land of Tibet; of the Wild Ass of Cutch in the sultry plains near the mouth of the Indus.

The Kiang of Chinese Tartary greatly exceeds that of the Donkey of Cutch in size; the stallions often stand 14 hands high. Major Charlton and Major Biddulph state that they neigh like a horse. When taken young they will become so tame as to be led about like a horse, and will follow horses almost anywhere. They live in a climate where the temperature is below the freezing point in the middle of the summer; yet they throw off their pale woolly coat during that season, and become bright bay.

The Donkey of Cutch is often domesticated in India.

(??) *A. Equuleus*, the Yo-to-tze. Yellowish red-clay colour. Tip of ears, mane, long hairs of tail, well-defined line down the back to middle of tail, and cross-band on the shoulder, three or four cross streaks on knees and hocks, black.

It is the *Asinus Equuleus*, the Yo-to-tze (H. Smith); *Asinus Hippargus*, the Yo-to-tze (H. Smith).

Dr. J. E. Gray says, "The specimen described by Colonel H. Smith was alive in a livery stable near Park Lane, London; it was said to have been brought from the Chinese frontier north-east of Calcutta. It was most probably a Kiang, or perhaps a mule between it and the Domestic Ass."

** Body with a black dorsal streak and many more or less distinct transverse or curved streaks. Ears rather short and broad-tipped. —The Zebras of South Africa.

Hippotigris (H. Smith); Hippotigrine group or Zebras (H. Smith).

† Hoofs slightly concave beneath. Legs white, not or only slightly cross-streaked.

Living on the open plains.

A. Quagga, the Quagga. Brown; head, neck, and withers, or front of body, blackish streaked; lower part of body, legs, and tail, white. Hoofs flattish beneath.

It is the *Asinus Quagga* (Gray); *Equus Quoagga* (Lesson); *Equus Quagga* (Gmelin); Female Zebra (Edw.); Le Couagga (Buffon; Kwagga, or Couagga (Buff.); Opeagha, or Quagga (Masson); *Hippotigris Quacha*, the Quagga of the Cape Colonists (H. Smith); Quagga (Shaw); Quacha (Penn.).

It is a native of the Cape of Good Hope, on open plains.

E. Isabellinus, Temm. 'MSS.' (H. Smith); *Hippotigris Isabellinus*, the Isabella Quagga (H. Smith); Ane Isabelle (Le Vaillant).

Lesson places the Quagga with the true horses, because the hair extends nearer to the base of the tail, overlooking the warts and other natural characters.

Quagga (*Asinus Quagga*).

Le Vaillant, as Colonel Smith observes, only saw, and did not possess, the Ane Isabelle. The specimen in the British Museum, described and figured by Colonel H. Smith, was certainly only a young Quagga in a very imperfect condition, having lost nearly the whole of its fur before it was stuffed. It was presented by Dr. Burchell as the skin of a Quagga.

A. Burchellii, the Peetsi, or Peechi. Pale brown, under side of body whitish; head, body, and upper part of leg, black streaked; tail, inside and lower part of leg, white. Hoof rather broad, only slightly concave beneath. Skull: suborbital foramen as in *E. Hemionus*.

It is the *Equus Zebra* (Burchell); *Asinus Burchellii* (Gray); *Equus Zebroides* (Lesson); *Equus Burchellii* (Bennett); *Equus Zebra*, male (F. Cuvier); *Equus montanus*, the Dauw (F. Cuvier); *Hippotigris Burchellii*, the Dauw (H. Smith); Burchell's Zebra (Harris); Striped, or Bonte Quagga of the Cape Colonists (Harris); Peet-sey of the Matahuli and Bechianas; Dauw (F. Cuvier).

It is a native of the plains of South Africa.

It is found in herds in every district north of the Orange River. It admits of being tamed to a certain extent with considerable facility, and occasionally a half-domesticated specimen is exposed for sale in Cape Town with a rider on its back. Even in the most tractable state to which it has yet been reduced, it is regarded as wicked, treacherous, obstinate, and fickle.

M. F. Cuvier has applied the Hottentot name for the true Zebra to this species, and used for it the name *E. montanus* that Burchell gave to that animal, though it only inhabits the plains.

†† Hoofs narrow, deeply concave beneath; legs cross-banded.—Living on the Mountains.

A. Zebra, the Zebra. White; head, body, and legs to the hoofs, black-banded; nose reddish; belly and inside of thighs not banded; tail end blackish. Hoofs narrow, deeply concave beneath. Skull: suborbital foramen as in *E. Hemionus*.

Zebra (*Asinus Zebra*).

It is the *Zebra Indica* (Aldrov.); *Equus Indicus* (Jonston); *Equus Brasiliensis* (Jacob); *Hippotigris* (Dio Cass. 'Hist.' l. 77). *Equus Zebra* (Linn.); *Asinus Zebra* (Gray); Zèbre (Buffon); Zebra (Ray); Sebra (Stubb); *Hippotigris campestris* (H. Smith); *Equus montanus* (Burchell); Male Zebra (Edwards); Wild Paard, or Wild Horse, of the Dutch Colonists (Burchell); Wilder Esel (Kolbe); Daow (or True Zebra) of the Cape Colonists (Harris); Zeura or Zuora (Lobo); Wild Ass (Kolbe); Var. (?) *Hippotigris Zebra*, the Zebra (H. Smith); *Hippotigris antiquorum*, the Congo Dauw or Zebra of Pigafetta (H. Smith); *Hippotigris antiquorum*, Angola Dauw (H. Smith).

It is a native of the mountains of South Africa.

Hybrids between the species of *Equidæ* are numerous. The offspring of the male Ass (*Asinus vulgaris*) and a Mare is called a Mule, which has generally the form, in a great degree, of the dam, and the head, ears, and tail of the sire. The Spanish mules are well known for their symmetry, sureness of foot, and unwearied activity, and are the produce of a breed of asses far beyond those of this country in stature, shape, and general appearance. The Hinny, which is the offspring of the Horse and the female Ass, is altogether inferior, and is less esteemed than the Mule. Hybrids have also been produced from the Horse and the Ass breeding with the Zebra or the Quagga. Two mules that belong to the Zoological Society are the offspring of the Ass and the Zebra. The Earl of Morton bred a female hybrid from a fine male Quagga and a Mare of nearly pure (seven-eights) Arabian blood.

It may be expected that we should here notice the question as to the power of reproduction in animals so bred between different species. Mr. Bell, in his 'British Quadrupeds,' has treated this subject in his usual luminous manner. After observing that the inquiry how far the power possessed by two animals of producing young on the one hand, or fertile young on the other, bears upon the generic or specific identity of the parents, is one of the greatest interest in the investigation of zoological relations, he proceeds thus:—"It has been supposed, and with very considerable probability, that the production of male and female progeny which are fertile inter se is to be considered in itself a positive proof that the parents are of the same species, how much soever they may differ in external form and appearance. It is well known that there are many instances of animals undoubtedly distinct producing young, which become fertile in conjunction with one or other of the parent kinds. This has been proved in the case of several species both of gallinaceous and natatorial birds in a domestic state; but there is not, I believe, on record a single instance of a male and female of such hybrid progeny being mutually fertile. On the other hand the production of sterile hybrids between distinct species of the same group is a circumstance so commonly occurring as to require only an illusion; and a reference to the present animal [the Mule] is a sufficent illustration of the fact. But the power of reproduction even of such progeny is considered by some as indicative of a generic relation between the parent species, and has been urged as an argument against the separation of the Horse as a distinct genus from the Ass and its congeners. Before this observation however can be allowed to have any weight, it rests with the objectors to define the precise meaning and limits of a genus; and until this has been done, which has never yet been satisfactorily attempted, such an argument is a mere begging of the question. The Mule has been occasionally known to produce young with the Horse or the Ass: these cases are however extremely rare, and serve as illustrations of the statements which I have already made, as there is no instance on record of two Mules having bred together." Mr. Bell notices the following fact, as one which must doubtless be placed to the account of this power of reproducing in the Mule. A small mare was turned into a paddock in the Gardens of the Zoological Society of London (Regent's Park), in company with a male white Ass, and a male hybrid between the Zebra and the Ass. She had a foal which was distinctly marked with black stripes across the legs.

While upon this subject, we may as well advert to the curious point, that the characters of the male parent of the mother's first progeny show themselves in her subsequent offspring by other males, however different those males may be in form or colour. Mr. Bell observes that this truth has already been illustrated by him when treating on the Dog and on the Hog, and he adds that it receives a remarkable and interesting confirmation from the case of the mare (belonging to the Earl of Morton) quoted by him and above alluded to. In that case the mare was young, and after producing the female hybrid by the Quagga, had first a filly, and afterwards a colt, by a fine black Arabian Horse. They both resembled the Quagga in the dark line along the back, the stripes across the forehead, and the bars across the legs: in the filly the mane was short and stiff, like that of the Quagga; in the colt it was long, but so stiff as to arch upwards and hang clear of the sides of the neck: in other respects they were nearly pure Arabian. This and other such cases should not be forgotten by breeders of animals, who are anxious about the perfection of their stock, and should make them particularly careful as to the male influence which first makes its impression on the female.

Fossil Equidæ.

Remains of *Equidæ* occur abundantly in the third period of the Tertiary series (Pliocene of Lyell), in the fresh-water deposits, in what is called Diluvial Detritus, in superficial gravels, sands, and clays, in the Ossiferous Caverns, in the Osseous Breccia, in the Epplesheim Sand, &c. Bones of the Horse occurred, but not abundantly, among the remains found by Captain Cautley lying on the slopes among the ruins of fallen cliffs, and partly in situ in the Sandstone in the Sewalik Mountains at the southern foot of the Himalayas, between the Sutlej and the Ganges. Several species have been recorded, but we must not forget the opinion of Cuvier, who thought there were not sufficient data for specific distinctions. He informs us that he had carefully compared the skeletons of many varieties of horses, those of the Mule, the Ass, the Zebra, and the Quagga, and he never could find a character sufficiently fixed to enable him to pronounce on a species from an isolated bone. Size, he remarks, furnishes but incomplete means of distinction: horses and asses vary much in this particular, from their state of domestication; and he adds, that though he had not yet procured the skeleton of a Dshikketee, he doubted not its resemblance to that of the other species as much as they resembled each other in the same particular. He therefore seems to be borne out in his opinion that comparative anatomy cannot solve the question whether the horse whose remains are found in a fossil state resembled the horses of the present day. The fossil species recorded by authors are *Equus fossilis* (*E. Adamiticus* of Schlotheim); *E.* (*Caballus*) *primigenius*; *E.* (*Mulus*) *primigenius*; *E.* (*Asinus*) *primigenius.* Professor Owen, in his 'British Fossil Mammals', has described three species of *Equidæ—Equus fossilis, E. plicidens,* and *Asinus fossilis.* Their remains were all found in the Tertiary Formations of England. He thus concludes his remarks on the Fossil *Equidæ*:—

"In reviewing the general position and distribution of the fossil remains of the genus *Equus*, we find that this very remarkable and useful form of Pachyderm first made its appearance with the Rhinoceros during the Miocene periods of geology. From the peculiar and well marked specific distinction of the primogenial or slender-legged horses (*Hippotherium*), which ranged from Central Europe to the then rising chain of the Himalaya Mountains, it is most probable that they would have been as little available for the service of civilised man as is the Zebra or the Wild Ass (*Equus Hemionus*) of the present day; and we can as little infer the docility of the later or Pliocene species, *E. plicidens* and *E. fossilis*, the only ones hitherto detected in Britain, from any characters deducible from their known fossil remains. There are many specimens however that cannot be satisfactorily distinguished from the corresponding parts of the existing species, *E. caballus*, which with the Wild Ass may be the sole existing survivors of the numerous representatives of the genus *Equus* in the Europeo-Asiatic continent during the Pliocene period. The species of *Equus* which existed during that geological period in both North and South America appears to have been blotted out of the Fauna of those continents before the introduction of man. The aborigines whom the Spanish conquistadors found in possession of Peru and Mexico had no tradition or hieroglyphic indicative of such a quadruped; and the horses that the invaders had imported from Europe were viewed with astonishment and alarm.

"The researches of Mr. Darwin and Dr. Lund have however indisputably proved that the genus *Equus* was represented during the Pliocene period by a species (*E. curvidens*) which is shown to be distinct from the European fossils and the existing species. Fossil remains of the Horse have likewise been discovered in North America. The geographical range of the genus *Equus* at the Pliocene period was thus more extensive than that of the Rhinoceros, of which both the extinct and existing species are confined to the continents of the Old World of geography. The Horse, in its ancient distribution over both hemispheres of the globe, resembles the *Mastodon*, and appears to have become extinct in North America at the same time with the *M. giganteus*, and in South America with the *M. Andium* and the *Megatherium.* Well may Mr. Darwin say, 'It is a marvellous event in the history of animals that a native kind should have disappeared, to be succeeded in after ages by the countless herds introduced with the Spanish colonist.'"

EQUISETA'CEÆ, *Horsetails*, a natural order of imperfectly-formed Plants whose real affinity is uncertain, and the nature of whose parts of fructification is not yet understood. By Linnæus and almost all botanists they are referred to the Cryptogamic class. With Ferns their relation is not obvious. In the arrangement of their reproductive organs they have a striking resemblance to *Zamia*, and in their general aspect to *Ephedra* or *Casuarina.* Dr. Lindley regards them as a high form of the muscal alliance, and places them near to *Marchantiaceæ.* Only one genus is known, the stems of a species of which are employed in the shops under the name of Dutch Rushes. They are hollow-stemmed leafless plants, with a cuticle composed of pure silex. In lieu of leaves they have toothed sheaths, each of which has as many series of imperfect spiral vessels passing into fistulæ of the stem as there are toothings. Their fructification grows in terminal cones, consisting of stalked peltate scales, having on their lower side small cases wherein are lodged minute oval or round green bodies, surrounded by four elastic hygrometrical yellowish-gray granulated clavate threads. By all botanists the central green body is admitted to be a seed or spore. The nature of the clavate threads is disputed; they are usually called Elaters, and are compared to the elastic spiral threads bearing that name in *Jungermanniaceæ;* but there is no proof of such being their nature, and there is an opinion that they are rudimentary stamens.

These plants are found in ditches and rivers in most parts of the world, within and without the tropics. None of them are of any medical use; they are said to be slightly astringent and stimulating, but are not now employed. The stems of some of them are used for polishing furniture and household utensils, owing to their siliceous properties. According to the observations of John of Berlin they contain 30 per cent. of siliceous earth. The quantity of silex contained in the cuticle of *E. hyemale* is so great that Sivright succeeded in removing the vegetable matter and retaining the form. [EQUISETUM.]

Equisetum fluviatile.

1, a sterile branch; 2, a fertile branch in fructification; 3, one of the peltate scales; 4, the same viewed from below; 5, two of the cases very much magnified; 6, an ovule with the four supposed anthers.

EQUISE'TUM (from 'equus,' a horse, and 'seta,' a hair or bristle, from the character of the leaves), a genus of Plants, the type and only genus of the order *Equisetaceæ.* The species are leafless branched plants, with a striated fistular stem, articulations sheathed at the base; the sporules are surrounded by elastic clavate filaments, and inclosed in thecæ arising from the peltate scales of terminal cones; the vernation is straight, and the cuticle abounds in silex.

E. hyemale, Dutch Rush, has a simple stem, very rough, with from 14 to 20 slender furrows: the sheaths close, whitish, but the top and bottom black; the teeth slender, black, deciduous. This plant is a native of England, Scotland, and Ireland, as well as the continent of Europe. It is almost unknown in the middle and southern English counties, and is only sparingly distributed anywhere. It was recommended as a medicine by the ancients, and the earlier herbalists quoted them as authorities for its virtues; but it is not now used in medicine. It appears however to possess tannin, and to act as an astringent. It is supposed to be injurious to cows, and is said to cause their teeth to drop out, but horses eat it with impunity. This plant more than any other species is used for the purposes of polishing. Lightfoot says that in Northumberland the milk-maids scour their pails with it. It is also used for the purposes of polishing wood, bone, ivory, and various metals, particularly brass, and is brought into this country from Holland, where it grows abundantly in large quantities, and is sold in the shops of London under the name of Dutch Rush. Mr. Newman thinks however that the *Equisetum* brought from Holland is a different species from the British *E. hyemale.* The stems of this plant contain large quantities of silex, and in the ash left after burning it forms as much as 97 per cent. On subjecting a portion of the cuticle of this species to the analysis of polarised light under a high magnifying power Brewster detected a beautiful arrangement of the siliceous particles, which are distributed in two lines parallel to the axis of the stem, and extending over the whole surface. The greater number of the particles form simple straight lines, but the rest are grouped into oval forms connected together like the jewels of a necklace by a chain of particles, forming a sort of curvilinear quadrangle, these rows of oval combinations being arranged in pairs. Many of these particles which form the straight lines do not exceed the 500th of an inch in diameter. Brewster also observed the remarkable fact that each particle has a regular axis of double refraction. A very large quantity of starch is found during winter in the rhizomes, in whose cells during the month of October the particles may be seen in active motion, passing up one side and retreating by the other, much in the same way as in *Chara*. This may also be seen in *E. fluviatile*.

E. Mackaii has a simple, or very slightly branched, very rough stem, with 8-12 furrows, the sheath close, ultimately wholly black; teeth slender, persistent. This plant occurs in the north of Ireland, and is named by Mr. Newman after its discoverer, Mr. I. T. Mackay, author of the 'Flora Hibernica.' Sir Wm. Hooker has referred this plant to the *E. elongatum* of Willdenow; but Babington has adopted Newman's species.

E. variegatum has a simple stem, or very slightly branched, very rough, with 5-9 furrows, the sheaths slightly enlarged upwards, green below, black above; the teeth obtuse, each tipped with a deciduous bristle. The stem is about a foot high. It is found on sands near the sea, or in wet places in mountain valleys in Great Britain.

E. palustre has the stem with 6-8 deep furrows, branched throughout; the sheaths loose, pale, with acute wedge-shaped teeth tipped with brown, and membranous at the edges. This plant is very generally distributed over Great Britain. This species is liable to alter its characters, and three tolerably permanent varieties have been described.

E. fluviatile, Water Horse-Tail, has a sterile stem, nearly smooth, with about 30 striæ and branches; branches rough, doubly angular, simple; the fertile stem simple, with numerous crowded large deeply-toothed sheaths. This is the *E. Telmateia* of Ehrhart and Newman's 'History of British Ferns.' Its present name was erroneously given it by Smith, which has been adopted by Hooker and Babington. It is one of the most beautiful of the species, attaining a height of 3, 4, and even 5 feet. It is abundant in the neighbourhood of London, especially near Hampstead Heath. It is a native also of the more southern countries of Europe. Although it grows in water, as its name would imply, it still grows in dry situations; and the name *fluviatile* is more applicable to the original plant of Linnæus, the *E. limosum* of English botanists. Horses sometimes eat this plant; and from a passage in Haller he seems to have supposed that it was eaten by the Romans: he says, "Hoc fuerit Equisetum quod a plebe Romanâ in cibum recipitur." (Haller, 'Hist.' iii. 1.)

E. limosum has a smooth stem, with 14-16 slight furrows; the teeth of the sheaths short, rigid, and acute; the branches erect, simple, whorled, often abortive. This is undoubtedly the *E. fluviatile* of Linnæus, but we have given the name of Smith, as that which has been followed by Hooker and Babington in their Floras of Great Britain. This plant is seen very commonly in ponds and ditches, and sometimes in running streams, the roots and a portion of the stem being immersed in water. It is a common plant throughout Europe. Linnæus says that in Sweden it is used as food for cattle, in order that the cows may give more milk, and also that the rein-deer feed on it. He advises that it should be collected in summer as fodder for the winter. Cattle in this country will sometimes eat it. Mr. Knapp also records the fact that the common water-rat is very fond of it. It is probable that in some states of the system of animals it acts medicinally; but neither this nor any other of the species of *Equisetum* would be fitted for the constant food of animals.

E. sylvaticum, Wood Horse-Tail, has the sterile and fertile stems, with about 12 furrows and numerous whorls of slender compound spreading or deflexed branches; the sheaths lax, with 6-10 membranous rather blunt teeth. It is found in wet shady places and moist woods throughout Great Britain.

E. Drummondii has the sterile stem, with about twenty striæ, very scabrous, with prominent points, particularly above; the branches simple, with four simple angles, the fertile stem simple, with numerous crowded deeply-toothed sheaths. This plant has not been long known as a native of Great Britain, but Mr. Newman thinks it is probably a common plant, and says it is identical with the *E. umbrosum* of Willdenow.

E. arvense, Corn-Field Horse-Tail, has the sterile stem, with few furrows, slightly scabrous; the branches simple, rough, with four simple angles, the fertile stem simple, with few lax distant sheaths. This is the most common of all the species, and frequently a source of serious injury to the farmer and gardener. It is subject to variation according to the locality in which it grows. It is easily distinguished from *E. umbrosum*, for which it might be mistaken by its drooping and compound branches.

(Newman, *History of British Ferns and Allied Plants*; Babington, *Manual of British Botany*; Loudon, *Encyclopædia of Plants*.)

EQUUS. [EQUIDÆ.]

ERA'NTHEMUM, a genus of Acanthaceous Plants, with showy purple flowers, some of whose species are occasionally seen in hothouses in this country. It has a salver-shaped corolla with a 5-cleft nearly equal limb, a 4-parted equal calyx, and only two out of its four stamens fertile. *Eranthemum pulchellum* and *E. bicolor* are the handsomest species in cultivation, and when skilfully managed produce a very striking appearance.

ERANTHIS, a small genus of Plants cut off from *Helleborus*, in consequence of its having a deciduous calyx, stalked capsules, an involucre to the flowers, and a totally different habit. *E. hyemalis*, or Winter Aconite, is a small stemless tuberous herbaceous plant, inhabiting shady places in the midland parts of Europe, and rendering our gardens gay in the earliest spring with its cups of bright yellow. It has peltate, many-cut, pale green, smooth leaves, and a single-flowered scape only a few inches high.

Another species, *E. Sibirica*, inhabits Siberia.

ERGOT, botanically considered, is a fungus belonging to the Gymnomycetous division, and constituting one of two species of *Spermœdia* admitted by Fries. He calls it *S. clavus*, and separates it from the genus *Sclerotium*, to which it had previously been referred, on account of its growing in the inside of other plants, and having no proper fructification. He defines the genus *Spermœdia* as follows: "Variable, rounded, entophytal, rootless, of a fleshy mealy homogeneous texture, with a rind concrete, scaly, or somewhat pruinose. Proper fructification none." And then he adds "that it is only a morbid condition of the grain of corn, not propagated by seed, but generated by a particular combination of external influences (cosmica momenta)." Endlicher takes the same view of the nature of ergot, only with more consistency he does not admit it as a real fungus, but only enumerates it as a diseased state of the seed of grasses, swelling into a fungoid body, and covered externally with powder. From the researches of the late Mr. Quekett it appears that a true fungus exists in the grain of rye during its early stages of growth, which gives it the peculiar appearance called Ergot. He describes the sporidia of this fungus as elliptical, moniliform, finally separating, transparent, and seldom containing more than one, two, or three well-defined greenish granules. Mr. Quekett called the fungus *Ergotetia abortifaciens*, in reference to its action on the system. For its action, see ERGOT, in ARTS AND SC. DIV.

The ergot of rye is not confined to that kind of grass, but attacks many other species. Fries distinguishes it by the lengthened form and white interior from *Spermœdia Paspali*, a Carolina ergot, which is globose and somewhat compressed, scaly and rough externally, pale brown and yellowish inside. A third species attacks Indian corn in Columbia, and has a pear-shaped figure.

ERGYNE. [ISOPODA.]

ERI'CA, a most extensive and beautiful genus of Plants, the type of the natural order *Ericaceæ*. It is distinguished by its calyx being 4-leaved, its corolla 4-toothed, and its fruit a dry, 4- or 8-celled, many-seeded capsule, opening into valves with the dissepiments projecting from their middle.

Under this character is included a great variety of species having very narrow linear leaves arranged in whorls, and so little different in their vegetation in most cases, that when out of flower they are often not easily distinguished from each other; but exhibiting a surprising diversity in their flowers, in which their great beauty resides. The richness of colour, the elegance and variety of form, the delicacy of texture, or the minute microscopic perfection of their corolla, are such as no words can describe. Lovely as even our wild moorland heaths are, they rank among the lowest in point of beauty in this extraordinary genus, in which all the hues of red, pink, and purple vie with each other in the most brilliant manner, assuming every tint but blue, and fading into the purest and most transparent white. Some of the species have the corolla as much as two inches long, in others it is not bigger than a pepper-corn; in some it is long and slender, in others inflated like a flask, or dilated like a vase of the purest form, or as round as an air-bubble; and there are many in which it is split almost to its base, and immersed in a calyx whose texture and colours are even more brilliant than its own. Here we have a species the surface of whose corolla rivals in evenness and polish the finest porcelain; there another appears covered all over with hairs, exuding a glutinous secretion, which glitters upon its sides like solid crystals; and some again have their colours so dimmed by a loose shaggy coat, that their real tint can hardly be ascertained. There are even some in which the corolla assumes the very colour of the leaves, only clearer, brighter, and richer. This great difference in the structure of the flowers of different species is accompanied by distinctions in their anthers, which are either muticous (destitute of appendages), cristate (furnished with two little broad projecting membranes), or aristate (that is, having a couple of bristle-shaped processes proceeding from their base). It has lately been proposed to take advantage of these and similar differences for breaking up the genus *Erica*, now consisting of between 300 and 400 supposed species, into a number of new genera; and accordingly in Don's 'General System of Gardening and Botany,' we find no fewer than twenty new groups formed at the expense of *Erica*.

The genus is confined to the Old World. A few species occur in the North of Europe, and others in the countries bordering on the Mediterranean. In Great Britain, Heather (*Erica*, or *Calluna vulgaris*) [CALLUNA] covers large tracts of waste land, and is used to thatch houses, to make brooms, and even beds, in the northern parts of the island. There is a double variety of this species which is extremely beautiful. All our British heaths are improved by cultivation, and are general favourites where the climate and soil are suited to them. They will not however thrive in hot dry places and in any common soil, but require sandy peat earth, and a situation where they are moderately shaded from the sun. *Erica carnea*, one of the few plants whose flowers bid defiance to the rigour of winter, and appear as the earliest harbingers of spring, is found wild in Germany and generally on the mountains of middle Europe.

But it is at the Cape of Good Hope that the principal part of the species is found; indeed the whole of those which are cultivated in greenhouses. In their native country they are by no means so handsome as when cultivated, but form scraggy shrubby bushes, with so little beauty, that the colonist boors have not vouchsafed to give them even a name.

ERICA'CEÆ, a natural order of Exogenous Plants, deriving their name from the extensive genus that forms the subject of the last article. It is readily known from all other orders by its anthers bursting by pores at their apex, the stamens being hypogynous, the corolla monopetalous, and the ovary containing more cells than two. By this character are combined with the genus *Erica* the fragrant richly-coloured *Azalea*, the shady evergreen *Rhododendron*, and the delicate irritable *Kalmia*, together with *Arbutus*, *Andromeda*, *Gaultheria*, and many others equally beautiful; in fact it is probable that if it were necessary for a botanist to name some one natural order as pre-eminent for beauty, this would be the one selected. It is therefore not a little curious that it should also be an order of poisonous plants; for one would hardly expect danger to lurk beneath forms so fair. Nevertheless *Rhododendron ponticum*, *Azalea pontica*, and various *Kalmiæ* and *Andromedæ* are notoriously deleterious, and even the *Arbutus* berries are in no inconsiderable degree narcotic.

The order is unknown in very hot countries, except at considerable elevations; it appears generally to love exposed situations, and, with the exception of *Erica* itself, to follow mountain chains, as it advances from the cool plains of the temperate zone to equinoctial regions. Hence, although we find *Befaria*, *Gaylussaccia*, *Andromeda*, and others in Peru, Brazil, Ceylon, Java, Madagascar, and elsewhere, it is only upon the tops of lofty mountains or upon their sides.

Ericaceæ are frequently polypetalous, and give rise, along with other similar cases, to a suspicion that the usual division of Exogens into polypetalous, monopetalous, and incomplete sub-classes, is essentially bad. [EXOGENS.]

Erica longiflora.

1, stamens and pistil; 2, calyx; 3, ovary; 4, anther; 5, section of seed, showing the embryo.

The following are the British species of this genus, with their distinctive characters, as given in Babington's 'Manual of British Botany:'—

* Corolla globose or urceolate, stamens included, filaments capillary, stigma peltate.

E. Tetralix, with the leaves 4 in a whorl, downy above and on the midrib beneath; the sepals linear, downy; the ovary downy. Its flowers are rose-coloured. It grows commonly on boggy heaths, and blossoms in July and August.

E. Mackaiana, Mackay's Heath. Leaves 4, midrib beneath and upper surface glabrous; the sepals ovate-lanceolate, and with the ovary glabrous. The flowers are purplish. The only locality known for it in the British Islands is between Roundstone and Clifden in Connamara, Ireland.

E. cinerea, Fine-Leaved Heath. The leaves are 3 in a whorl, keeled beneath, with a central furrow; glabrous flowers in dense whorled racemes. Flowers reddish-purple. It is found on dry heaths.

E. ciliaris. Leaves 4 in a whorl, ovate, ciliated; flowers in terminal unilateral racemes. It is a rare plant.

** Corollas campanulate or shortly tubular, stamens exserted, filaments flattened, style capitate.

E. Mediterranea. Leaves 4 in a whorl, linear, glabrous above, convex, with a central furrow beneath; corolla cylindrical, urceolate; anthers without awns. Found in Ireland, in mountain bogs in the west of Mayo and Galway.

E. vagans, Cornish Heath. Leaves 4-5 in a whorl, corolla most campanulate. Flowers red or white; anthers purple. It is found in the western parts of Cornwall in England, and on the coast of Waterford in Ireland.

ERICHTHUS, Latreille's name for a genus of deep-sea Crustaceans, and placed by M. Milne-Edwards between the genera *Squillerichthus* and *Alima*. The last-named author makes the tribe Erichthians (Erichthiens) belong to the family of Unicuirassiated Stomapods (Stomapodes Unicuirassés), the general characters of the tribe being an undivided carapace and a styliform rostrum; no moveable rostral plate; and branchiæ in general rudimentary.

The tribe, according to M. Milne-Edwards, is composed of a certain number of small crustaceans approximating to the *Squillæ*, but which have in general only rudimentary branchiæ, and are often completely deprived of them. They are easily distinguished by their carapace, which is large, lamellar, generally transparent, without longitudinal furrows or distinct lobes, and always armed with a styliform rostrum, which advances above the ophthalmic and antennular rings. These first two rings of the head are less distinct than they are in *Squilla*, but have very nearly the same conformation, and move upon the succeeding cephalic segment. The internal antennæ are inserted below and behind the ocular peduncles; they are rather distant from each other, and their slender and cylindrical peduncles are composed of three joints, and carry at their extremity three multiarticulate filaments. The external antennæ are inserted at some distance behind the preceding, and are directed outwards; their peduncle is large, and formed of two joints, of which the first gives origin by the anterior border of its extremity to a slender and short stem (tige), composed of two peduncular joints and a multiarticulate filament, the second carrying at its extremity a large oval-shaped blade or lamina with ciliated edges. The epistome is not projecting and swollen as in *Squilla*, and the mouth resembles a pear-shaped tubercle, situated near the middle or towards the posterior third of the lower surface of the carapace. The upper lip has the form of a triangle, with a rounded base which is directed backwards. The mandibles are vertical, swollen at their base, and armed with two branches with dentilated borders, the upper of which raises itself into the interior of the pharynx; their palpiform stem (tige) is either rudimentary or null. The lower lip is large and composed of two swollen lobes. The jaws are small, and of the same conformation as those of *Squilla*, excepting that those of the second pair are narrower. The members which represent the anterior jaw-feet, the prehensile feet (pates ravisseuses), the three pairs of subcheliform feet applied against the mouth, and the three pairs of natatory feet, which terminate the series of thoracic members, are formed and disposed in the same manner as they are in *Squilla*. It is only to be remarked that often the three pairs of subcheliform feet are less approximated to the mouth than they are in the *Squillæ*, and that those of the last three pairs are sometimes rudimentary. The carapace is prolonged more or less far beyond the last rings of the thorax, or even beyond the first segments of the abdomen, but without adhering thereto. The abdomen is elongated; its last segment is very large, and entirely covers the appendages of the preceding ring, which are short, but formed like those of the *Squillæ*. Finally, the false feet suspended from the first five rings of the abdomen are more slender and more elongated than in the other division of the family, and, as has already been noticed, present in general only the vestiges of branchiæ.

The *Erichthi* have as yet occurred hardly anywhere else than in the ocean (haute mer), and have hitherto been found only in tropical regions. The following are the characters of the genus:—

Squillerichthus.—Carapace armed with spiniform prolongations and covering the base of the internal antennæ, but posteriorly it does not overpass (not comprising the spines) the last ring of the thorax. The rostrum is styliform and very long. The eyes are large, pear-shaped, and articulated, on a very slender and rather long cylindrical peduncle. The ophthalmic ring is not distinct from the antennular ring, as in the *Squillidæ* but the mode of insertion of the antennæ is the same as in those animals and in the *Erichthi*. The antennæ of the first pair are directed forwards, and present nothing remarkable. The external antennæ are directed outwards, as in the *Erichthi*, and present also a large peduncle, carrying at its extremity a large oval-shaped lamina ciliated all round, and giving insertion, by its anterior border, to a very short stemlet (tigelle), composed of two peduncular joints and a terminal filament. The mouth is little distant from the base of the antennæ, and situated towards the middle of the carapace. The upper lip is large, demicircular, and projecting. The mandibles are directed downwards as in the *Squillæ*, and there is a large denticulated tooth and a prolongation equally dentilated on its edge, which mounts towards the stomach, but the palpiform stem is null or rudimentary. Behind the mandibles are found a large inferior bilobated lip, and then two pairs of jaws, the form of which is the same as in the *Squillidæ*. The appendages that correspond to the jaw-feet of the first pair present nothing remarkable; they have the form of a long and slender stem, and, as in the other crustaceans of this family, do not seem to form a part of the buccal apparatus. The members of the following pair are very large, and constitute prehensile feet (pates ravisseuses), exactly similar to those of the *Squillæ;* their penultimate articulation is enlarged and spinous towards the base, and their terminal claw is short, and armed with spiniform teeth on the prehensile edge. The feet of the three following pairs are inserted on a transverse curved line immediately behind the prehensile feet, and are habitually applied against the mouth exactly as in the *Squillidæ;* each of these carries at its base a flattened disc-like, vesicle, and is terminated by an oval cheliferous manus. The three last thoracic rings are complete, and free below the carapace, which covers the first two. The three pairs of corresponding feet are of moderate size, and formed as they are in the *Squillidæ*, only their last joint is not setiferous. The abdomen is large, and much resembles that of the *Squillæ*, except that the last segment is much larger, and habitually covers the members of the penultimate ring. These last organs are composed, as in the *Squillæ*, of a peduncular joint, which prolongs itself inferiorly into a great lamina, and carries two appendages inserted on its edges near its base. The internal appendage consists of a great ciliated lamina, and the external one is composed of two joints, of which the last is oval, and the penultimate joint armed with spines on the external border. The false feet suspended from the first five rings of the abdomen are large, and formed of a nearly square peduncular joint, and of two great oval laminæ with ciliated edges; the internal lamina bears on its internal edge a small rudimentary appendage, and the external gives insertion, near its base, to a large ramose branchia.

M. Milne-Edwards, who founded this genus, and whose description we have above given, considers that *Squillerichthus* forms the passage between the *Squillæ* and the *Erichthi*.

It has only been found as yet in the Asiatic seas.

The species (two only are recorded) are small.

S. typus. Rostrum advancing beyond the peduncle of the internal antennæ; a great horizontal spine on the middle of the posterior border of the carapace; and, on each side, another and longer spiniform elongation, springing from the angle of the carapace; finally, a rather strong point towards the middle of the lateral border of the carapace, and another above the base of the external antennæ. Claws of the prehensile feet armed with four teeth (including the terminal point). The last thoracic ring is not covered with the carapace, and the abdomen is very large. Its last segment is much longer than it is wide, and armed with three pair of marginal teeth. Length about 15 lines. Found in the seas of Asia. (Milne-Edwards.)

The other species recorded by M. Milne-Edwards, *S. spinosus*, was taken by M. Dussumier in the Gulf of Bengal.

Erichthus.—Carapace very large, convex, and armed with spiniform elongations. It entirely covers the base of the ocular peduncles, as well as of the antennæ, and extends backwards more or less far beyond and above the abdomen, which is short and large. The eyes are large, pear-shaped, and are not carried on a slender and elongated stem, as in the *Squillerichthi* and *Alimæ*. The antennæ present nothing remarkable, except that the stemlet (tigelle) of those of the second pair is often rudimentary, and that those of the first pair are rather short. The mouth is formed in the same manner as it is in the *Squillerichthi*, only the external jaws are extremely small, and narrower. The jaw-feet of the first pair are extremely slender, and of moderate length; they are slightly enlarged towards the extremity, and have a rudimentary nail or claw at the end. The prehensile feet are but little developed; their claw is nearly straight and without dentilations, and the penultimate joint is slender, elongated, straight, and devoid of spines. The feet of the three following pairs are formed in the same manner as they are in *Squillerichthus*, but they are inserted one after the other; the flattened vesicle fixed at the base of each of these organs, as well as of the members of the two preceding pairs, is very large. The thoracic feet of the last three pairs are formed in the same manner as in *Squilla* and *Squillerichthus*, but are little developed, and sometimes want the styliform appendage; at other times they are entirely rudimentary, and are only composed of a small peduncle, terminated by two articulations nearly like the false abdominal feet, but much smaller. The abdomen is wide and short; the caudal fin which terminates it is disposed as in *Squillerichthus*, and the false feet of the first pair are large, and terminated by two great oval laminæ, on one of which is a rudimentary branchia.

M. Milne-Edwards, who gives the above characters, divides the nine species into the following sections:—

α. Species whose rostrum is very long, and passes sensibly beyond the internal antennæ.

Ex. *E. vitreus* (*Smerdis vulgaris*, Leach). Locality, the Southern Atlantic Ocean.

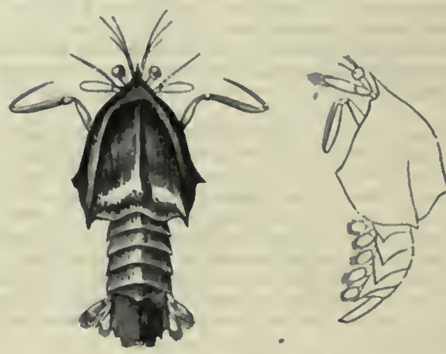
Erichthus vitreus.

β. Species whose rostrum is of moderate length, and passes beyond the peduncle of the internal antennæ without attaining to the extremity of those appendages.

Ex. *E. armatus* (*Smerdis armata*, Leach). Locality, coasts of Africa.

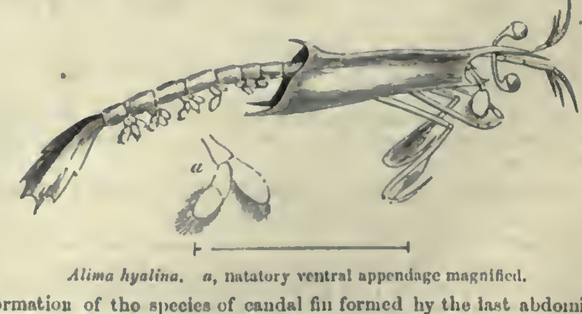
γ. Species having the rostrum extremely short (not passing beyond the peduncle of the internal antennæ).

Ex. *E. Duvaucellii.* Locality, Gulf of Bengal.



Erichthus Duvaucellii.

Alima.—Carapace narrow, straight above, if not altogether so behind, where it often presents a sudden roof-like elevation; rostrum straight and styliform. The anterior angles of the carapace constitute two acute spines directed forwards; the posterior angles are also prolonged into the form of points directed backwards on each side of the abdomen. Finally, the lateral borders of the carapace are nearly straight. The opthalmic and antennular rings are not hidden under the carapace as in *Erichthus*, but are seen uncovered under the rostrum. The eyes are carried on slender long cylindrical peduncles directed outwards. There is nothing particular about the antennæ. The mouth is situated very far from the front, towards the posterior third of the lower surface of the carapace; the upper lip, the mandibles, the lower lip, and the two pairs of jaws, have the same form as in *Erichthus* and *Squillerichthus*. The thoracic feet are formed also in the same manner as in *Erichthus*, but the three pairs of members which follow the prehensile feet are more approximated to the mouth, as in the *Squillæ*. The posterior border of the carapace is ordinarily notched, so as to leave uncovered the two last thoracic rings, and the abdomen is narrow and elongated. The false feet are large, but are in general completely devoid of branchiæ: sometimes vestiges of these organs are found upon the abdominal members of the first pair, and at other times they are represented by a small pediculated tubercle fixed to the external blade of these appendages. Finally, the con-



Alima hyalina. *a*, natatory ventral appendage magnified.

formation of the species of caudal fin formed by the last abdominal segment and the false feet of the sixth ring are entirely the same as in *Erichthus*. M. Milne-Edwards, whose description we have given, states that the *Alimæ* bear an extremely strong resemblance to the

Erichthi, but always have the body more elongated. Their manners, he adds, are not known, and he divides the five species into the following sections:—

a. Species which have the hand of the prehensile feet unarmed with spines.

Ex. *A. hyalina* (Leach). Locality, Cape Verd.

β. Species which have the hand of the prehensile feet armed with teeth or spines on the prehensile border.

Ex. *A. laticauda.* Locality, New Guinea. (Quoy and Gaimard.)

M. Milne-Edwards observes that the species figured by M. Guerin under the name of *A. triacanthura*, belongs to this division, and seems to be distinguished from the other species by the brevity of the rostrum, the shortness of the lateral blades of the caudal fin, &c.

A. longirostris of the same naturalist has not, according to M. Edwards, been described, but seems to approach very nearly to the preceding species.

ERIGERON, a genus of Plants belonging to the natural order *Compositæ*, the sub-order *Corymbiferæ*, the tribe *Asteroideæ*, the sub-tribe *Asterineæ*, the divisiou *Astereæ*, the sub-division *Erigereæ*. It has many-flowered radiant heads; the flowers of the ray ligulate, with pistils only, and in many rows, those of the disc tubular; mostly with both stamens and pistils, the receptacle naked and foveolate; the involucre imbricated, the pappus pilose in one or many rows, the fruit compressed.

E. Philadelphicum has the stem slightly furrowed, downy, with spreading hairs; the leaves of the root cuneate-obovate, sometimes deeply sinuate, the upper becoming gradually entire, obloug-lanceolate, and amplexicaul; the florets of the ray 1-200, pale purple, slightly bifid. This plant is a native of North America, and is used as a medicine in the United States. It possesses stimulant properties, and is given as an emmenagogue; it also acts on the kidneys, and is considered a valuable diuretic. It has a powerful fetid smell.

E. acris has the stem corymbose, the branches alternate, bearing single heads; the leaves linear, lanceolate, entire, spreading; the lower leaves narrowed below; the ray erect, scarcely longer than the disc; the inner female florets filiform, numerous. It has a stem 6-18 inches high; the flowers yellow in the disc and pale blue in the ray. The ashes of this plant contain about 5 per cent. of potassa, and it is sometimes burned for procuring the alkali. It has a strong scent, and like many other species of the family is said to keep away fleas. With species of *Conyza* [CONYZA] and *Pulicaria* [PULICARIA], it has the name of Flea-Bane. It is a native of Europe, and is a common plant in Great Britain. *E. Canadensis* and *E. alpinus* are also found in England and Scotland: tho first is a rare plant, aud is found on waste grouud; the second is a native of highland mountains. The species are numerous, and some of them are ornamental plants.

(Babington, *Manual*; Burnett, *Outlines of Botany*; Lindley, *Flora Medica*.)

ERINACEUS, a genus of Animals to which the Hedgehog (Hérisson of the French) is referred. The Hedgehogs are placed by Cuvier at the head of the Insectivorous Mammifers; and M. F. Cuvier observes that in *Chrysochloris* the normal system of dentition of the *Insectivora* may be seen reduced to tho narrowest dimensions, whilst in the Hedgehogs it appears to be brought to the greatest development.

Dental Formula:—Incisors, $\frac{6}{2}$; canines, 0; molars, $\frac{7-7}{7-7}=36$.

It has the following characters:—Body covered with spines, with the power of rolling itself up into a ball by means of appropriate muscles; muzzle pointed; ears more or less apparent; tail short; each foot 5-toed, and armed with robust claws.

The species of Hedgehog have been recorded as inhabitants of Europe, Africa, and India.

E. Europæus, tho Common Hedgehog, is the Riccio of the Italians; Erizo of the Spanish; Ourizo of the Portuguese; L'Hérisson of the French; Igel of the Germans; Egel-Varken of the Dutch; Pin-Suin of the Danes; Draenog and Draen y Coed of the Welsh; Urchin of the British; *Echinus terrestris* of Gesner; *Echinus* (*Erinaceus*) *terrestris* of Ray; and *Acanthion vulgaris* of Klein. There can be little doubt that it is the *Echinus* (Ἐχῖνος) of Aristotle.

This indigeuous animal is too well known to need a lengthened description. The length is generally rather more than 9 inches.

The food of the Hedgehog, which is a nocturnal animal, consists principally of insects, worms, slugs, and snails. That it will eat vegetables is shown by White of Selborne, who relates how it eats the root of the plaintain by boring beneath it, leaving the tuft of leaves untouched. In the 'Zoological Journal' (vol. ii.) is an account by Mr. Broderip of an experiment made by Professor Buckland, proving that in captivity at least the Hedgehog will devour snakes; but there is no good reason for supposing that it will not do the same in a state of nature, for frogs, toads, and other reptiles, and mice have been recorded as its prey. From its fondness for insects it is often placed in the London kitchens to keep down the swarms of cockroaches with which they aro infested; and there are generally hedgehogs on sale in Covent Garden market for this purpose. It is hardly worth while to refute the idle story that this persecuted animal sucks the cows; but according to Sir William Jardine it is very foud of eggs, and is consequently mischievous in the game-preserve and hen-house. The Hedgehog hybernates regularly, and early in the summer brings forth from two to four young ones at a birth, which at the time of their production are blind, and have the spines white, soft, and flexible. The nest wherein they are cradled is said to be very artificially constructed, the roof being rain-proof. The mother has been known to eat her young in confinement.

The flesh of the Hedgehog wheu it has been well fed is sweet and well-flavoured, and is eaten on the continent in many places. In Britain few besides the gipsies partake of it. The prickly skin appears to have been used by the Romans for hackling hemp.

Among the foreign *Erinaceadæ*, *Erinaceus spatangus* and *Erinaceus Grayii* will be found recorded in the 'Proceedings of the Zoological Society' for 1832. Both came from the Himalaya Mouutains, and the latter was considered by Dr. Gray to be identical with *Erinaceus collaris*, figured in the 'Illustrations of Indian Zoology.' Mr. Bennett however regarded it as a new species, inasmuch as *Erinaceus Grayii* was destitute of a white collar, and differed in other particulars from the figure referred to. A species from the interior of South Africa, forming part of the collection brought from that country by Mr. A. Steedman, *Erinaceus frontalis*, is recorded iu the same volume of the 'Proceedings.'

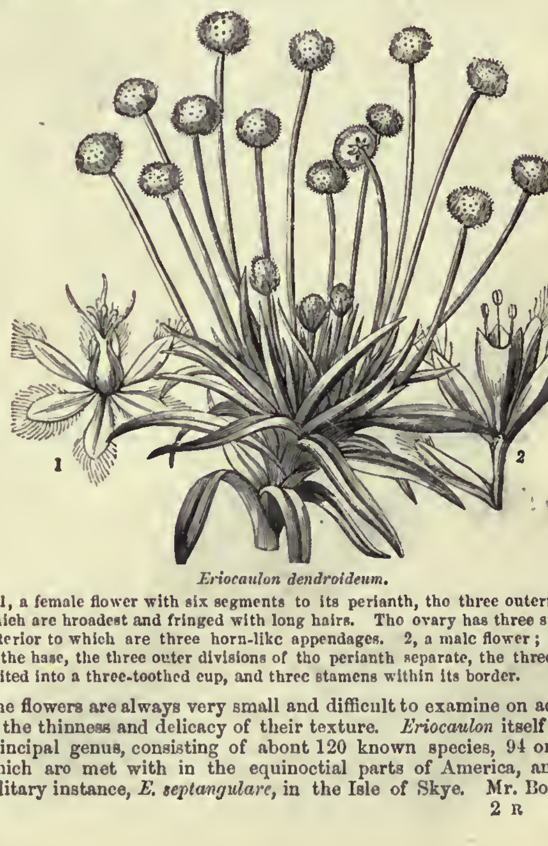
Dr. Gray places the sub-family *Erinacina* under the family *Talpidæ*.

The following species are to be found in the list of specimens of *Mammalia* in the British Museum:—*E. mentalis*, Himalaya; *E. auritus*, Siberia; *E. frontalis*, South Africa; *E. collaris*, India; *E. Grayii*, India; *E. Europæus*, England; *E. spatangus*, India.

ERINITE, a Mineral consisting of Arseniate of Copper. It occurs in conceutric and mammillated layers, between which other arseniates are found. The layers have rough surfaces and a fibrous structure. The colour is a brilliant emerald-green inclining to grass-green. Streak paler. Fracture uneven or imperfect conchoidal. Its hardness is 4·5 to 5·0. Lustre slightly resinous. Slightly translucent. The specific gravity 4·0 to 4·1. It is found near Limerick. Its analysis, by Turner, gives:—

Arsenic Acid	33·78
Oxide of Copper	59·44
Alumina	1·77
Water	5·01

ERIOCAULACEÆ, *Pipeworts*, a group of Endogenous Plants subordinate to *Restiaceæ*, for the most part inhabiting swampy or marshy places, or the bottom of lakes, and having the flowers collected into dense heads. The sexes are separated; the perianth consists of from 2 to 6 divisions immersed in soft bracts; there are from 2 to 6 stamens; the styles are 2 or 3; the cells of the ovary are the same number, and the seeds solitary, with lines of hairs upon their surface. The embryo is placed on the outside of the albumen at the apex of the seed.



Eriocaulon dendroideum.

1, a female flower with six segments to its perianth, the three outermost of which are broadest and fringed with long hairs. The ovary has three stigmas, exterior to which are three horn-like appendages. 2, a male flower; a bract at the base, the three outer divisions of the perianth separate, the three inner united into a three-toothed cup, and three stamens within its border.

The flowers are always very small and difficult to examine on account of the thinness and delicacy of their texture. *Eriocaulon* itself is tho principal genus, consisting of abont 120 known species, 94 or 95 of which aro met with in the equinoctial parts of America, and one solitary instance, *E. septangulare*, in the Isle of Skye. Mr. Bongard, who has written a monograph of the South American species, states that in that part of the world, although they prefer marshy and inundated places, yet some are found upon damp sand, others among grass, and some in dry and stony places; they are also frequently met with in alpine situations, some as high as 5590 feet above the sea on the summit of Mount Itambé. The preceding figure of *Eriocaulon dendroideum* gives a correct notion of the appearance of these plants.

ERIODENDRON, a genus of Plants belonging to the natural order *Sterculiaceæ*, known by the name of Wool-Trees. The wool-trees are large trees, with a spongy wood which is used for little besides making canoes in the districts where they grow. The leaves are palmate, and the flowers are large, red, white, or scarlet, and rising singly or in clusters from the sides or tops of the branches. The calyx is naked, irregularly 5-lobed, with the lobes usually twin; the petals are 5, joined together, and are connected with the column of the stamens at the base. The filaments of the stamens are joined together into a short tube at the base, and divided into 5 bundles at the apex; these bundles are filiform, and each bears 1, 2, or 3 linear or anfractuous anthers at the apex, which have the appearance of one anther, and are either adnate or versatile. The stigma is 5- or 6-cleft. There are 6 species of *Eriodendron*, 5 of which are natives of America, and 1 of Asia and Africa.

E. anfractuosum has versatile anfractuous anthers; leaves with 5, 7, or 8 entire cuspidate leaflets, glaucous beneath and a usually prickly trunk. This tree attains a height of 150 feet or more. There are two varieties described, the one growing in the East Indies and the other in Guinea. They differ chiefly in the colour of their flowers. The Indian species, *E. a. Indicum*, has flowers yellowish inside and white outside; whilst the Guinea species, *E. a. Africanum*, has large crimson flowers. In Guinea this tree is one of the largest and tallest of the forest-trees, and the trunk is employed for making the largest-sized canoes.

E. Samamna has versatile anfractuous anthers; leaves with 5-7 oblong, quite entire, acuminated leaflets; the petals obovately spatulate, covered with glabrous down on the outside. The flowers are cream-coloured, and are seated on the tops of the branches. The wool contained in the fruit is used in Brazil for stuffing pillows, bolsters, beds, &c. It is found in Brazil near the river Yupura.

E. Jasminodorum has anfractuous anthers; a jointed style; leaves with 3 ovate, acute, entire leaflets; the petals reflexed; the tube of the stamens thickened at the top and entire, with the filaments 1-anthered. This plant is a native of Brazil, in the province of Minas Novas. It has white flowers smelling very like to those of the jasmine.

The wool-trees may be grown in this country with heat. They may be propagated by cuttings which will root freely in sand under a hand-glass, but the plants which are produced from seeds thrive best. They do not usually produce their beautiful flowers till they are of large size in their native countries; therefore it can hardly be expected they should flower in this country.

ERIOMYS. [CHINCHILLIDÆ.]

ERIO'PHORUM, the systematic name of the sedge-like Plant which is called in this country Wild Cotton or Cotton-Grass, in consequence of the long cottony tufts which wave upon its stalks in marshy and sedgy heaths and wastes in all parts of this country. The appearance is owing to the hypogynous scales, which, in this glumaceous genus, represent the calyx, being extended into long numerous white hairs, which project far beyond the scales of the flower-head. It is not a little curious that while, in most of the species, these hairs are indefinitely numerous, they should in one, *E. alpinum*, be reduced to the regular number, six, which is the general proportion of floral envelopes belonging to Endogens. Professor Kunth enumerates twelve species, all inhabiting the colder parts of the northern hemisphere. The silky or cottony substance which clothes the fruit of the species of this genus is made into paper and the wicks of candles; it is also used for stuffing pillows, &c. The leaves of *E. comosum* are in the Himalayas extensively employed in the manufacture of ropes.

ERI'PHIA, Latreille's name for a genus of Brachyurous or Short-Tailed Crustaceans.

Carapace less wide, and more quadrilateral than in the other Cancerians; length two-thirds more than the breadth; the fronto-orbital border occupies more than one-half, and sometimes more than three-fourths of its breadth; and the latero-anterior borders, directed nearly right backwards, only describe a slight curvature, and prolong themselves but little. Orbits, as in the genus *Ruppellia;* but the space which separates their edges from the basilary joint of the external antennæ is very considerable; this joint is but little developed, and does not occupy a fourth of the space comprised between the antennary fossette and the internal canthus of the eyes; on the contrary, the moveable stem of the external antennæ is much more developed than in the *Ruppelliæ*, and is inserted at a small distance from the antennary fossette. For the rest, not differing from the other Cancerians.

M. Milne-Edwards, whose description we have given, says, that the *Eriphiæ*, which he places among the Quadrilateral Crustaceans, approach the *Ruppelliæ* nearly, but that the general form of the body of *Eriphia* tends to establish a passage towards the *Thelphusæ*. He divides the species into the following sections:—

α. Species having the hands (manus) tuberculous.

* Front armed with spines.

Ex. *E. spinifrons* (*Cancer spinifrons*, Herbst). It inhabits all seas (Milne-Edwards.)

Eriphia spinifrons.

** Front devoid of spines.

Ex. *E. gonagra* (*Cancer gonagra*, Fabricius). Found on the coasts of South America.

Eriphia gonagra.

β. Species having the hands (manus) smooth, not tuberculous.

Ex. *E. lævimana.* It inhabits the Isle of France.

Eriphia lævimana.

M. Milne-Edwards observes that the *Eriphia* figured by Savigny ('Egyp'., pl. 5, fig. 1), and referred with doubt by M. Audouin to *E. spinifrons*, appears to him (Edwards) to be a distinct species; and that *E. prismatica* of Risso has not been described with sufficient details to justify its reference to this genus with certainty. *Cancer Eurynome* (Herbst) appears to M. Edwards to be an *Eriphia*.

ERLANITE, a Mineral containing Silica, Alumina, &c. It occurs massive and amorphous. Its fracture is in some specimens foliated, in others splintery. The structure granular and compact. Colour light greenish-gray. Streak white, shining. Hardness 6·25 to 7·0. Lustre feebly shining, or dull. Opaque. The specific gravity 3·0 to 3·1. It is found near Erla in the Saxon Erzgebirge, forming a bed of 100 fathoms in thickness. Its analysis, by Gmelin, gives:—

Silica	53·16
Alumina	14·03
Lime	14·39
Magnesia	5·20
Soda	2·61
Oxide of Iron	7·14
Oxide of Manganese	0·64
Water	0·60

ERMINE. [MUSTELA.]

ERNE. [FALCONIDÆ.]

ERNTO. [CYPRÆIDÆ.]

ERO'DIUM (from ἐρώδιος, a heron), a genus of Plants belonging to the natural order *Geraniaceæ*. It has 5 sepals, 5 petals, 10 monadelphous stamens, 5 fertile and 5 sterile with glands at their base; the fruit beaked, separating into five 1-seeded capsules, each with a long ultimately spirally-twisted awn, bearded internally. The species are herbs or undershrubs, having variously-formed leaves, membranous stipules, and many-flowered peduncles. The species of this genus, like those of *Geranium* and *Pelargonium*, are numerous, upwards of fifty having been described.

E. cicutarium, Hemlock-Leaved Heron's-Bill, has a procumbent hairy stem, the peduncles many-flowered, the claws of the petals ciliated, the perfect stamens dilated, not toothed below, glabrous, the beak hairy, the leaves pinnate, the leaflets sessile, pinnatifid, cut. The flowers are purplish or white. It is a native throughout the whole of Europe, and is found in the north of Africa. It is abundant on sandy soils and waste ground in Great Britain. There are several well-marked varieties, some of which may be really species, as the *E. c. pimpinellæfolium*.

E. moschatum, Musky Heron's-Bill, has a procumbent hairy stem, many-flowered peduncles, the claws of the petals not ciliated, the perfect stamens toothed at the base, glabrous, the beak downy, the leaves pinnate, the leaflets nearly sessile, ovate, unequally cut. It is found in waste places in Great Britain, but is an unfrequent plant. It is a larger plant than the preceding, and emits, when handled, a strong musky odour. It is very generally diffused, and has been found all over Europe, at the Cape of Good Hope, and in Peru.

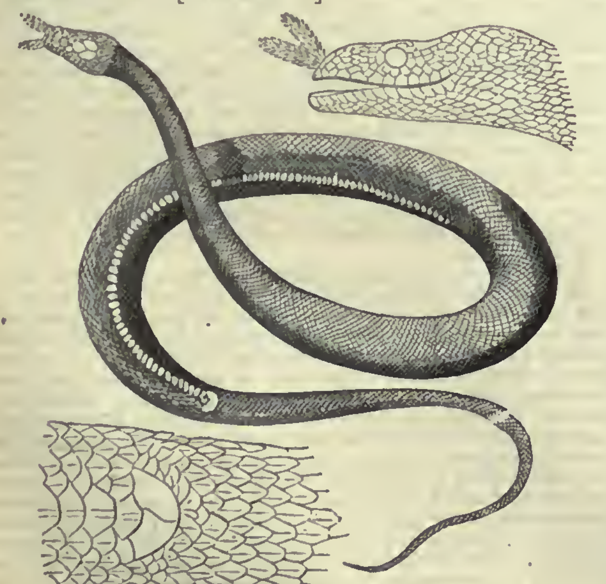
E. maritimum, Marine Heron's-Bill, has a prostrate slightly-hairy stem, the peduncles 1-2-flowered, the petals very minute, the leaves simple, ovate, cordate, stalked, lobed, and crenate. It is a rare plant, but a native of Great Britain, in sandy places near the sea.

Most of the remaining species are natives of Europe; some are found in the north of Africa, two or three in Asia, and the same number in America; but the mass of them are truly European. The perennial species are ornamental, and will thrive well in any kind of garden soil. They may be propagated by dividing the roots or by seed. Many of the annual species are handsome plants, and may be propagated by seed, which ripens in this country, and only requires to be sown in the open border to spring in any kind of soil.

EROPHILA. [DRABA.]

EROTYLUS. [TETRAMERA.]

ERPETOLOGY. [HERPETOLOGY.]



Herpeton tentaculatus.

E'RPETON, Lacépède's name for a genus of Serpents, placed by Cuvier next to *Eryx*. The name should be written *Herpeton*.

The genus is furnished with two soft prominences, covered with scales on the muzzle. The head is protected by large plates; those beneath the belly are not large, and those beneath the tail scarcely differ from the other scales. The tail however is very long and pointed. Cuvier, who speaks of the priority of Lacépède, who first described the genus under the name of *Erpeton*, remarks that Merrem has changed the name to *Rhinopirus*.

ERRATIC BLOCKS are those weather-worn and more or less rounded fragments of the harder rocks which are found very widely scattered over the surface of the earth, and at great distances from the places whence they are supposed to be derived.

In size they vary from 10,000 cubic feet and upwards to a few inches. M. Brongniart has proposed to designate the several sizes by particular names, as gigantic, metric, cephallary, pugillary, &c. But in England we generally confine the term Erratic Blocks to the larger masses, calling those of middling size Boulders, and arranging the smaller along with gravel: this is however too vague. The nature of Erratic Blocks is not less various than their size. Every species of rock seems to have contributed a portion of its substance towards the mass, though the harder, being better capable of resisting the disintegrating and corroding influence of atmospheric causes, are found in the greatest abundance, such as quartz, petrosilex, greenstone, granite, porphyry, syenite, gneiss, primitive and transition limestone, dolomite, serpentine, siliceous pudding-stones, siliceous sandstones, &c.

The distribution and situation of these blocks are also very different. Seldom isolated, they are generally found in patches or groups, as in the environs of Geneva, the plains of Westphalia, in Sweden, &c.; or in long bands or trains, as in the north of Mecklenberg Strelitz, where they run in a direction west-north-west and east-south-east; or widely spread over considerable tracts, as between Warsaw and Grodno, between St. Petersburg and Moscow, in East Prussia, &c. Sometimes they cover horizontal plains, as in the north of Germany; sometimes they rest on the sloping sides of mountains, as in the Alps and the Jura, and occasionally on the very tops of lofty eminences, as on the summits of the calcareous mountains of Rettwick, of Rædaberg, and of Osmund, about 6000 feet above the level of the sea. Sometimes they are seen in greatest abundance at the bottom of valleys where they open into the plains, and in other instances they are found collected in the largest quantity in the high and narrow parts of the valleys, as is observed at Detmold and east of Lemgo. At times they are so abundant as to be accumulated into hills of a particular form, as is the case in Smaland, in Sweden; and sometimes they form even mountains of considerable height, as may be seen near Quedlie, in Norway; and what is remarkable, the larger blocks are at the top, the others diminishing gradually towards the bottom.

Though generally superficially disposed, Erratic Blocks are however in some places found imbedded in a fine sand which has nothing in common with their nature or origin, as in the plains of Westphalia. Some blocks (and this may depend either on their own particular nature, or the greater or less friction to which they have been subjected, the length of time they have been exposed to atmospheric influence, or the nature of the climate), have their angles and edges as sharp as though they were just detached from their native mountains, as is the case in the neighbourhood of Groningen.

When the Erratic Blocks are not at any great distance from the spots whence they come, they may be easily traced up to their origin. Thus those which are in the basin of the Rhine come from the Grisons; those of the valley of the Lake of Zürich and of the Limmat have been detached from the mountains of Glaris; those of the basin of the Reuss come from the rocks at the source of this river; and those of the Aar and the Jura from the lofty mountains in the canton of Berne. Even those which cover the widely extended tract from Holland on the west, to St. Petersburg and Tver on the east, are supposed by Von Buch, Hausmann, Brugmans, Alex. Brongniart, &c. to be traceable to Scandinavia. It is however remarkable that, contrary to what is generally observed of transported debris, the blocks are frequently largest as they are farthest removed from the place whence they came, diminishing gradually in size as they approach the parent rock; thus the blocks found in Mecklenberg and Seeland, which are ascertained to be derived from the Scandinavian peninsula, are larger than the blocks of the same rocks in Scania and East Gothland, and they disappear altogether close to the primordial mountains whence they were derived.

In certain places the blocks are almost exclusively of a particular kind, while in others they vary greatly in their mineral character, proving, together with the ascertained situation of the same rocks in situ, that they must have been assembled from various quarters. This is the case with the Erratic Blocks of Yorkshire, and with those of Lithuania, for though the greater part, perhaps, of those in the latter locality may be similar to the rocks in Sweden and Norway, there are many evidently derived from other places.

As for the direction in which the bands of Erratic Blocks seem to lie, and the quarter whence they seem to have come, they are very various. We have just seen that in the north of Mecklenberg the trains are in a line west-north-west and east-south-east. Count Rasoumovski observes that, when many blocks are accumulated they form parallel lines with a direction from north-east to south-west. Brongniart says they have a general direction north and south. Sir James Hall speaks of those in the neighbourhood of Edinburgh as coming from the west. We have said that those on the north of the Alps come from the south.

If anything further were necessary to complicate the problem of Erratic Blocks, it is the immense distance at which they are sometimes found from the nearest rocks of similar composition; thus blocks of granite are found on the mountains of Potosi, while the nearest granite rocks are in Tucuman, about 400 leagues off. Nor is distance all; the detached blocks are found separated from their parent rocks by intervening hills, broad and deep valleys, as that of the Aar, and even by straits and seas: thus in the north of Cumberland there are boulders which have been transported across the Solway Frith from Dumfries, and the blocks on the low plains of Germany are separated from their parent rocks by the Baltic.

England, as well as the continent of Europe, has many spots covered with Erratic Blocks, some of which seem to be derived from Norway, while others are evidently the debris of our own mountains. For details we refer the reader to the observations and works of Sedgwick, Conybeare, Lyell, Buckland, Phillips, Hibbert, &c.

Erratic Blocks are also common in America and other parts of the world.

From what has been already said, and from the circumstance of Erratic Blocks lying on some of the most modern formations, it will be easily conceived that they present one of the most inexplicable of geological phenomena. The blocks on the Jura, and from the Alps generally, having first attracted notice, have given rise to a great variety of hypotheses, the most remarkable of which are the following:—1. De Luc was of opinion that these blocks had been projected into the air by the same force which upheaved the Alps, and that they had fallen at greater or lesser distances, according to the strength and direction of that force. 2. Von Buch, Escher, &c., attribute their existence to an immense débacle which swept down the blocks from the Alps to the foot of the Jura, up the slope of which they were forced by the impulse they had received, in the same way as a ball rolled along with force rises up a hillock. 3. Others, as Daubuisson, have thought that these blocks, which are almost wholly of transition rocks, were the remains of a mantle of these rocks, of later formation than the limestone of the Jura, and consequently much more recent than is generally admitted, and which, having been destroyed, left nothing but these testimonials of their former existence. 4. Dolomieu supposed that the summits of the Alps were formerly connected with those of the Jura by an inclined plane, which has been destroyed by the same revolution that precipitated the blocks from the summit of the Alps to the plateau, and into the valleys of the Jura. 5. Venturi has attempted to explain the passage of the blocks from the Alps into the basin of the Po, by floating them down on rafts of ice. 6. Others have upheaved the Jura, which they suppose to have been formerly on a level with the base of the Alps, and with it the blocks which had rolled down upon this calcareous plain. 7. Finally, Von Buch, extending his general theory to the particular phenomenon, thinks that the dispersion of the blocks is the result of an upraising of the Alps posterior to the formation of the tertiary rocks.

M. Brongniart very justly observes that these hypotheses leave many difficulties unexplained: he conceives that as the phenomenon of Erratic Blocks is a very general one, it is presumable that the cause also is general. Certain it is that even if it were possible satisfactorily to assign a cause for the Erratic Blocks found upon the Jura, the same reasoning would hardly be applicable to other cases; and in the utter impossibility of discovering any single cause competent to the production of such different effects, we must have recourse to the more probable conjecture of M. Larivière, that the dispersion and disposition of Erratic Blocks have been effected in different ways. The more powerful cause however he conceives to be the transporting power of icemeers and icebergs, in which opinion he is followed by Mr. Lyell and others.

Erratic Blocks, like other phenomena, are attended with their peculiar advantages: thus on hot and dry soils, and when not in too great abundance, they keep the soil cool and moist, sheltering it from the direct rays of the sun in the day, and thus diminishing the evaporation of its moisture. On cold soils they tend to maintain an equable warmth by diminishing radiation at night. In some countries they are the only building-stones, as in East Friesland and the neighbourhood of Groningen. In others they supply the necessary lime, as at Königsberg, Revel, &c. Those of a convenient size are used in Russia and Poland for paving the towns: when broken they are exceedingly well adapted for the repairs of roads.

ERRINA. [MILLEPORIDÆ.]

ERU'CA, a genus of Plants belonging to the natural order *Cruciferæ*, and to the tribe *Brassiceæ*. It has an erect calyx, obovate petals, distinct, not toothed stamens; an oval, oblong, two-celled, two-valved, silique; smooth concave valves, with an ensiform seedless beak, scarcely shorter than the valves; the seeds globose. The species are annual branched herbs, with erect terminal racemes of flowers, which are white and yellow, and remarkable for their beautiful reticulation of brown veins.

E. sativa, Garden-Rocket, has lyrate pinnatifid leaves, with toothed acute lobes, a hairy stem, the pedicels shorter than the deciduous calyx. It is a native of cultivated fields and waysides in the north of Africa, in Spain, Portugal, France, Italy, Switzerland, and Greece. It is very subject to varieties, and many have been described by various botanists. Although mostly hairy, sometimes its stem is smooth. In height it varies from three inches to two feet, and the flowers are very variable in the depth and arrangement of their colours. When full grown it has an acrid and unpleasant taste, and a strong, peculiar, almost fetid smell; but when young and tender it is frequently eaten as a salad, especially on the Continent. It is the Roquette Cultivée and La Rocket des Jardins of the French, Raukette of the Germans, and Ruccola of the Italians. The whole plant has been used in medicine as a sialagogue. The ripened seeds are a good substitute for the seeds of the mustard, but not so pungent. When cultivated as a salad, the seeds should be sown in a warm border early in February, and again in March and April for successive crops. The plants should be thinned, after they have produced the first rough leaves, to about three or four inches apart, and they should be kept clear of weeds. If a supply is required throughout the year, the seeds may be sown every month. The plants sown in February should be allowed to produce seed, which ripen in August, and may be used for all the sowings. *E. hispida* and *E. vesicaria* are European plants, and when cultivated as ornament need only to be sown in the open border and treated as other hardy annuals.

(Lindley, *Flora Medica*; Don, *Dichlamydeous Plants*.)

ERUCASTRUM, a genus of Plants belonging to the natural order *Cruciferæ*, and to the tribe *Brassiceæ*. It has a square pod, the valves convex, with one straight nerve, the seeds oval or oblong in a single row. This genus has been formed by Schimper and Spenner for some of the species of the old genus *Sinapis*. *E. incanum*, the *Sinapis incanus* of Linnæus, has been found in sandy places in Jersey and Alderney, and has consequently a place in the British Flora. It has adpressed pods, which are turgid, with a short one-seeded beak. The stem reaches from one to three feet high. This plant is also a native of the South of Europe, especially Spain: and is the *Cakile Hispanica* of L'Heritier; the *Hirschfeldia adpressa* of Moench. Koch, in the 'Synopsis Floræ Germanicæ et Helveticæ,' gives three species of this genus as natives of Switzerland and the upper district of the Rhine. (Babington, *Manual of British Botany*; Don, *Dichlamydeous Plants*.)

ERUCIVORA. [LANIADÆ.]

ERVUM, a genus of Plants belonging to the natural order *Leguminosæ* and the tribe *Vicieæ*. It is known by a 5-cleft calyx, with linear acute segments, about equal in length to the corolla; glabrous stigma; an oblong 2-4-seeded legume. Most of the species of this genus are weeds, two of which, the *E. hirsutum* and *E. tetraspermum*, are found in Great Britain. The former is called Tine-Tare, and is a great pest in corn-fields.

E. Lens is the plant which produces the Lentil. It has branched stems; oblong nearly glabrous leaflets, usually eight in number; the stipules lanceolate and ciliated; the peduncles 2-3-flowered, about equal in length to the leaves; the legumes short, broad, finely reticulated; seeds two, compressed. It is a native of corn-fields on the continent of Europe. Lentils are not much eaten in this country, but they are consumed in considerable quantities in France, Germany, and Italy. The Lentil is one of the oldest leguminous plants used as food of which we have any record. Ever since the time of Esau they have been eaten in the East. In Egypt and Syria they are parched in a frying-pan and sold in the shops, and are considered by the natives as the best food for those who are on long journeys. The Lentil is still cultivated in this country. There are three varieties known in France and Germany: the small brown, which is the lightest-flavoured and the best for soups; the yellowish, which is a little larger and the next best; and the Lentil of Provence, which is almost as large as a pea, with luxuriant straw, and it might be cultivated as food for cattle.

In its cultivation the Lentil requires a dry warm soil; it should be sown later than the pea, at the rate of a bushel or a bushel and a half to the acre. It ripens earlier than the pea, and requires the same treatment and harvesting. The produce of the Lentil in grain is about a fourth less than that of the tare, and the straw is not more than a third as much. The straw is however considered very nourishing, and is used for feeding calves and lambs. Lentils, like all other leguminous fruits, contain a large quantity of nitrogenised matters. Einhoff found that 3840 parts of lentils contained 1260 parts of starch and 1433 parts of a matter analogous to animal matter. In a late analysis made by Dr. Playfair for the Royal Agricultural Society he found that 100 parts of lentils contained 33 parts of albumen or gluten and 48 parts of starch, &c.; whilst the same quantity of peas contained 29 parts of albumen, and of beans 31 parts. If the theory of nutrition propounded by Professor Liebig in his late work on 'Animal Chemistry' be correct, then lentils constitute one of the most highly nutritious foods in nature.

ERYCINA. [VENERIDÆ.]

ERY'NGIUM, a genus of Plants belonging to the natural order *Umbelliferæ*, and the tribe *Saniculæ*. It has a calyx of five leafy teeth, the petals erect, oblong, with a long inflexed point; the fruit obovate, covered with chaffy scales without ridges or vittæ. The species are usually perennial spiny herbs, with the flowers congregated into oblong or roundish dense heads.

E. maritimum, Sea-Holly, has the radical leaves roundish, plaited, spurious stalked, the upper leaves embracing the stem, palmately lobed; the leaves of the involucre 3-lobed, spurious, longer than the heads; the scales of the receptacle 3-lobed. The stem is more than a foot in height, and is branched and leafy. It is a native of Europe on the sands of the sea-shore, and is found on the European and African shores of the Mediterranean Sea. It is abundant on the eastern shores of England, and is found in Scotland and Ireland. The plant is called in England Sea-Eryngo, Sea-Hulver, and Sea-Holme. According to Linnæus the flowering shoots are very good when boiled and eaten like asparagus. The leaves are sweetish, with a warm aromatic flavour. The root also is sweet to the taste, and has an aromatic smell. It has been used in medicine as a tonic, and Boerhaave regarded it as a valuable aperient and diuretic. The root is also supposed to possess aphrodisiac virtues. It is candied, and sold in the shops of London as a sweetmeat. There is still an establishment at Colchester, in Essex, where the roots are candied, in which town this preparation was first made, more than two centuries since, by Robert Buxton, an apothecary. It is not now much used by medical men, but at one time it had a reputation in many diseases.

E. campestre has the radical leaves two or three times pinnatifid, spinous, stalked; the stem-leaves embracing the stem, bi-pinnatifid; the leaves of the involucre lanceolate, spinous, longer than the heads; the scales of the receptacle undivided. It is a more bushy and slender plant than the last. It grows on waste ground and in dry sandy fields, and is a very common plant in the south of Europe. It is found in England and Scotland, but is a rare plant. There is a plant found on the banks of the Tyne called *E. campestre*, but Mr. Babington thinks this may be a different species. The plant which Ray describes as growing on the shore, called Friar's Goose, below Melling, in Yorkshire, Mr. Babington thinks requires further examination, before determining the claim of this plant to be considered a true native of Great Britain.

E. fœtidum has the radical leaves lanceolate, bluntish, narrowed at the base, spinous; the floral leaves palmate, sessile; the leaves of the involucre lanceolate, much longer than the heads; the palea among the flowers entire. It is a native of Jamaica, Guyana, Demerara, Florida, and Brazil, in fields and woods. The negroes and poorer whites in Jamaica regard this plant as a valuable remedy in hysterical fits; hence it is called in the West Indies Fit-Weed. It is admistered in the form of a decoction or infusion of the whole plant.

E. aquaticum, Rattle-Snake-Weed, has the leaves broadly linear, with parallel nerves; the lower leaves ensiform; the floral leaves lanceolate, toothed; the leaves of the involucre shorter than the heads of flowers; the stems dichotomous. It is a native of North America, from Pennsylvania to Virginia. It is also found in the Society Islands, California, and Buenos Ayres. It inhabits marshes, inundated pastures, and the banks of rivers. This plant is employed in North America as an application to the bite of the rattle-snake; hence its common name.

Nearly 100 species of this genus have been described. They are found in greatest numbers in America, but many are inhabitants of Asia, Africa, and Europe. They are most of them handsome and ornamental plants, and worthy of cultivation. They will grow freely in any common garden soil, but the lighter or more sandy the soil the better they will grow. Some of the species require the greenhouse or frame, and they should be grown in pots. They may be propagated by dividing the roots, or by sowing the seed.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*; Lindley, *Flora Medica*.)

E'RYON, Desmarest's name for a Macrourous Crustacean only known in a fossil state.

External antennæ short (one-eighth of the total length of the body including the tail), setaceous, provided at their base with a rather large scale, which is ovoid and strongly notched on the internal side; intermediate antennæ setaceous, bifid, much shorter than the external ones, and having their filaments equal. Feet of the first pair nearly as long as the body, slender, linear, not spinous, terminated by very long and narrow chelæ, with fingers little bent, but slightly inflected inwards; carpus short; feet of the other pairs also slender, and those of the second and third pairs terminated with pincers, like the feet of the crawfishes (écrevisses). Carapace very much depressed, wide, nearly square, but little advanced anteriorly, profoundly notched on its latero-anterior borders. Abdomen rather short, formed of six articulations, of which the four intermediate ones have their lateral borders prolonged in angles, well detached, as in the crawfishes. Caudal fin formed of five pieces, of which the two lateral are entire, rather large, a little rounded on the internal side, and the three middle ones triangular and elongated, especially the intermediate one.

It is found in the lithographic limestone of Pappenheim and Aichtedt in the margraviate of Anspach. (Desmarest.)

M. Desmarest observes that this genus is entirely anomalous, and ought in a natural classification to form a section by itself. According to the method of Dr. Leach it would belong: 1st, to the order *Macroura*; 2nd, to the second section, which includes those *Macroura* which are provided with a caudal flabelliform fin; 3rd, to the subsection *B*, which have the peduncles of the internal antennæ moderately elongated; 4th, to the fifth division, which have the natatory blades of the extremity of the tail formed of a single piece, the second articulation of the abdomen not dilated, and rounded anteriorly and posteriorly on each side: and, finally, feet to the number of ten.

M. Desmarest goes on to say that it is to the *Callianassæ*, the *Thalassinæ*, the *Gebiæ*, and the *Axii*, that *Eryon* bears relation. Nevertheless it has not, he observes, the habit of any of them. Its short depressed carapace, and its little elongated abdomen, approximate it to *Scyllarus*, but its internal antennæ with short peduncles, its external setaceous antennæ, and its greater anterior didactylous feet, widely separate it from that genus. It cannot be confounded with *Palinurus*, which has the external antennæ and the peduncles of the internal ones so long, and whose feet are all monodactylous; and, finally, it cannot be referred to the crawfishes or lobsters (*Astacus*), whose shell is differently formed, and which have the external natatory blades of the tail composed of two pieces; but Desmarest thinks that it is to the last-named genus that *Eryon* most approximates, taking into consideration its general character. He regrets that he has not been able to satisfy himself whether the four antennæ are inserted on the same horizontal line or not, a fact which would have assisted him in his comparison with other genera.

E. Cuvieri. Carapace finely granulated above, marked by two deep and narrow notches on the two latero-anterior borders, and finely crenulated on the latero-posterior borders. Length 4 to 5 inches, French.

Eryon Cuvieri.

The fossil was noticed by Richter, Knorr, and others, before M. Desmarest, as indeed he states.

ERY'SIMUM (from ἐρύω, to draw), a genus of Plants belonging to the natural order *Cruciferæ*, and to the tribe *Sisymbreæ*. It has a tetragonal pod, the valves prominently keeled with one longitudinal nerve, the stigma obtuse, entire or slightly emarginate, the seeds in a single row, the funiculus filiform. The species are annual, biennial or perennial herbs, with variable leaves, and elongated, termina many-flowered racemes.

E. Alliaria of Linnæus, Smith, Schkuhr, and others, is generally now admitted as the type of a new genus, *Alliaria* of Adanson. It differs from *Erysimum* in not having its valves keeled with a single nerve, but having 3 longitudinal nerves, and in the seeds being striated, and the funiculus flattened and winged. *E. Alliaria* is the *A. officinalis* of Andrzeijowski, who is followed by De Candolle in his 'Prodromus,' and Babington in his 'Manual.' Koch however follows Scopoli, and places it in *Sisymbrium* as *S. Alliaria*; from which genus it differs only in its flattened winged funiculus. It has heart-shaped leaves, the lower ones being reniform and coarse, repando-crenate; the pods are erect and patent, much longer than their stalks, and the seeds are oblong and cylindrical. The stem is erect, one to two feet high, and slightly branched. The flowers are white. It is a native all over Europe, under hedges and in ditches. It has a strong smell, and a taste not unlike garlic, for which it is frequently used as a substitute, whence it has obtained its Latin name *Alliaria*, from 'allium,' garlic. It is very generally used by the poor people of the countries in which it grows as a condiment, with bread and butter, salted meats, or in salads. In England it is known by the name of Sauce Alone, and Jack by the Hedge. In German it has several names, as Das Knoblauchkraut, Der Knoblauchhederich, Lauchel

Waldknoblauch, Ramfen, Ramschelwurzel, Gernsel, Salsekraut, Saskraut. In French it has the names L'Alliare, L'Herbe aux Aillets, &c. Although not often found on the tables of the middle or upper classes, Mr. Neill says, that "when gathered as it approaches the flowering state, boiled separately, and then eaten to boiled mutton, it certainly forms a most desirable pot-herb, and to any kind of salted meat an excellent green." Linnæus says that sheep and cows and poultry eat it, but that horses and goats refuse it. When eaten by cows it gives a disagreeable flavour to the milk. Poultry also which eat it have a bad flavour when cooked. The seeds when powdered produce sneezing, and have been employed as a sternutatory. The leaves were formerly used as a diaphoretic, and a poultice of them was recommended as an antiseptic in gangrenous and cancerous ulcerations.

A second species of *Alliaria* has been described as *A. brachycarpa*, a native of Iberia.

E. cheiranthoides, Worm-Seed, Treacle-Mustard, has oblong-lanceolate leaves, sligbtly toothed, with stellate three-parted hairs, all narrowed into a sligbt footstalk, tho pedicles longer than the calyx, two or three times shorter than the pods; the pods patent, ascending; the seeds small, numerous. It is a native of Europe, also of North America. It is found not uncommonly in Great Britain; it inhabits cultivated ground, waste places, and osier holts. It varies greatly in size according to situation. The flowers are very numerous, small, and yellow. It has obtained its name Worm-Seed from the fact of its seeds being sometimes used as a remedy for intestinal worms. It was also formerly employed as an ingredient in the famous Venice Treacle, and hence the whole genus have been called Treacle-Mustard. Babington marks this and all other species of *Erysimum* as plants that have been possibly introduced into Great Britain, though now looking very like true natives.

E. virgatum has linear lanceolate leaves, entire, with stellate two- or three-parted hairs, the lower ones narrowed into a footstalk, the upper leaves mostly sessile, tho pediclos as long as the calyx, many times shorter than the pod, the pod erect, the seeds large. It is found in Great Britain plentifully near Bath. It is also a native of the Alps and of Holland.

E. orientale has elliptical heart-shaped obtuse leaves clasping the stem, the radical leaves obovate, all smooth, glaucous, undivided, entire. This is the *Coringia orientalis* of Andrzeijowski, and *E. alpinum* of Baumgartner, and *Brassica alpina* of Linnæus. It is a native of the south of Europe, and is found in England and Ireland, in fields and cliffs near the sea. It has white or cream-coloured flowers. There are about fifty species of *Erysimum*, most of them natives of Europe, and a few in the temperate districts of Asia, Africa, and America. Some of them are ornamental and worthy of cultivation. The perennial herbaceous species are well adapted for the flower-border, and may be grown in any common garden soil. The smaller species may be employed for ornamenting rock-work, and many of them may be grown in pots with other alpine plants. The perennial species may be propagated by cuttings, by dividing the roots, or by seeds. The annual and biennial species may be sown in the open ground.

(Babington, *Manual of British Botany;* Don, *Dichlamydeous Plants;* Sowerby, *English Botany.*)

ERYSIPHE. [FUNGI.]

ERYTHACA, a genus of Birds belonging to the family *Sylviadæ*, the order *Insessores*, having the following characters:—Beak rather broad and depressed at the base, becoming narrower towards the point, and slightly compressed; upper mandible deflected and notched. Nostrils basal, lateral, oval, pierced in a membrane partly hid by feathers and hairs projecting from the base of the beak. Wings rounded; the three exterior quills graduated; the first only half as long as the second, which is shorter than the third; the fourth, fifth, and sixth longer than the third; the fifth the longest in the wing. The tarsus longer than the middle toe; the lateral toes nearly equal to each other in length; the outer toe united at its base to the middle toe; the claw of the hind toe longer and stronger than the others.

E. rubecula, *Sylvia rubecula*, *Motacilla rubecula*, the Robin Red-Breast, Robin-Redstart, Robinet, Ruddock, is so generally distributed over the British Islands, and so universal a favourite, that all are sufficiently interested in the bird to make themselves acquainted with its habits. These may be observed in any garden, field, or wood, for there is scarcely a hedge without its Robin inhabitant, and if Robins appear to be more numerous in winter than in summer, it is partly owing to the state of vegetation at the former season, which leaves them more exposed to observation, and partly because they resort to the habitations of men for food, when other means of supply fail. The song of the Robin is sweet and plaintive, but not very powerful. Mr. White of Selborne, says, "The robin sings all through the year. The reason that he is called an autumn songster is, because in the spring and summer his voice is lost in the general chorus, while in the autumn it becomes distinguishable."

The Robin is one of the latest birds to retire to rest, and the earliest to be seen moving in the morning, requiring apparently but little sleep.

This bird is very easily tamed, soon becomes familiar with those who feed it, and constantly builds its nest in places frequented by man.

Mr. Blackwall relates that a pair of Robins built their nest in a small saw-pit. Soon after the hen had begun to sit the sawing of timber was commenced at this pit, and though this noisy occupation was carried on every day close to the nest during the hatching of the eggs and rearing of the young birds, the old birds exhibited no signs of alarm or interruption. These birds exhibit great attachment to each other, and many instances have been related to prove that they pair for life. With all his interesting qualities the Robin is one of the most pugnacious of birds, and not only maintains his right against all intruders, but is said to kill those of his own family when they become troublesome to him. Robins breed early in the spring. The nest is composed of moss, dead leaves, and dried grass, lined with hair, and sometimes a few feathers; it is frequently placed on a bank sheltered by brushwood, or a short distance above the ground in a thick bush or lane hedge, sometimes in a hole of a wall partly covered with ivy. The eggs are from five to seven in number, white, spotted with pale reddish-brown; the length nine lines and a half, by seven lines and a half in breadth. The bird is found all over England, Ireland, and Wales, it is also an inhabitant of the most northern counties of Scotland. It also visits Denmark and Sweden in the breeding season; and so well does it bear cold weather, that among the summer visiters to the latter country, the Robin is one of the first to come and the last to go.

It is a constant resident throughout the year in all the temperate and warmer parts of Europe, abundant in Spain and Italy, Sicily, and Malta.

In the adult bird the beak and irides are black; upper part of the head, neck, back, upper tail-coverts, and tail-feathers, a yellowish olive-brown; quill-feathers rather darker, the outer edges olive-brown; greater wing-coverts tipped with buff, over the base of the beak, round the eye, the chin, the throat, and the upper part of the breast, reddish-orange, encircling this red is a narrow band of bluish-gray, which is broadest near the shoulders; lower part of the breast and belly white; sides, flanks, and under tail-coverts, pale brown; under surface of wing and tail-feathers dusky gray; legs, toes, and claws, purple brown. The whole length of the bird is 5¾ inches. The female is not quite so large as the male, and her colours are less bright. The young birds, after their first autumn moult, resemble adult females; but the red of the breast is tinged with orange, and the legs are dark brown. The Red-Breast is subject to variation in the colouring of the plumage. White and partly white varieties are not uncommon.

(Yarrell, *British Birds;* MacGillivray, *Manual of British Birds.*)

ERYTHRÆA, a pretty genus of annual Plants belonging to the natural order *Gentianaceæ*, and inhabiting dry sandy places in Great Britain and other parts of Europe, especially near the sea.

E. pulchella has an erect, much branched, acutely quadrangular stem; the leaves ovate, the uppermost oblong-lanceolate; flowers, all stalked, axillary, and terminal, the calyx rather shorter than the tube of the opening corolla, the lobes of the corolla elliptic oblong, obtuse. The inflorescence is forked, the lateral flowers distant from the floral leaves. It is found in sandy ground in England.

E. Centaurium, Common, or Lesser Centaury, has an erect branched stem, elliptic oblong leaves, the upper ones acute; flowers nearly sessile, corymbosely panicled; the calyx not half as long as the tube of the opening corolla; the lobes of the corolla oval. It is found in dry pastures in Great Britain. It flowers in August, at which time it is to be collected. The whole plant is taken up. It has a square stem, with opposite entire 3-nerved leaves. It is devoid of odour; the taste is strongly bitter, but not unpleasant: 100 parts of the fresh herb dry into 47; 10 lbs. of the dry herb yield by a single decoction 3 lbs. of extract. It contains a principle called Centaurin, which at present is known only as a dark brown extract-like mass; but which, united with hydrochloric acid, furnishes an excellent febrifuge medicine. As a bitter, it suits irritable systems better than any article of that class of medicines, and is therefore to be preferred. In other respects it has the general properties of bitter tonics.

E. latifolia and *E. littoralis* are both British species of this genus, found near the sea-shore. All the species are extremely bitter, and are collected by the country people under the name of Centaury as a substitute for Gentian in domestic medicine.

ERYTHRI'NA, a genus of Tropical Trees and Tuberous Herbs belonging to the natural order *Leguminosæ*. The species have ternate leaves and clusters of very large long flowers, which are usually of the brightest-red; whence the species have gained the name of Coral-Trees. Frequently their stem is defended by stiff prickles. They occur in the warmer parts of the Old and New World. An Indian species, *E. monosperma*, is said to yield gum-lac. De Candolle mentions 32 species; of which *E. Crista Galli* is commonly cultivated in green-houses for the sake of its splendid blossoms.

ERYTHRINUS, a genus of Tropical Fishes belonging to the family *Clupeidæ*.

ERYTHRO'NIUM, a genus of Plants belonging to the natural order *Liliaceæ*. *E. Dens Canis*, a pretty little bulbous plant (whose name, Englished Dog's-Tooth Violet, is derived from the form of its long slender white bulbs), is a native of woody subalpine places among bushes and stones, in Croatia, Idria, and about Laybach; it also occurs in Switzerland, but more seldom, and is also met with in the north of Italy. It is not mentioned in the Floras of the south of Europe. Two or three varieties are known in gardens as gay hardy flowers appearing early in the spring; one with purple, a second with white flowers, and a third, elevated by some into a species, with a somewhat stronger habit of growth.

E. Americanum is said to be emetic.

ERYTHROPHYS. [Cuculidæ.]

ERYTHROXY'LEÆ, a group of Exogenous Plants, considered by some as a distinct natural order; by others as a subordinate division of *Malpighiaceæ*. They have alternate stipulate leaves and small pallid flowers. The calyx is 5-lobed; the petals are 5, with a remarkable appendage at their base, which afford one of the marks of distinction between *Erythroxyleæ* and *Malpighiaceæ;* the stamens are 10, slightly monadelphous. The ovary is superior, 3-celled, with 3 styles, and solitary pendulous ovules. The fruit is drupaceous. Some of the species of *Erythroxylon*, the only genus, have a bright-red wood, occasionally used for dyeing; but the most extraordinary species is the *Erythroxylon Coca*, an account of the inebriating effects of which is given under Coca.

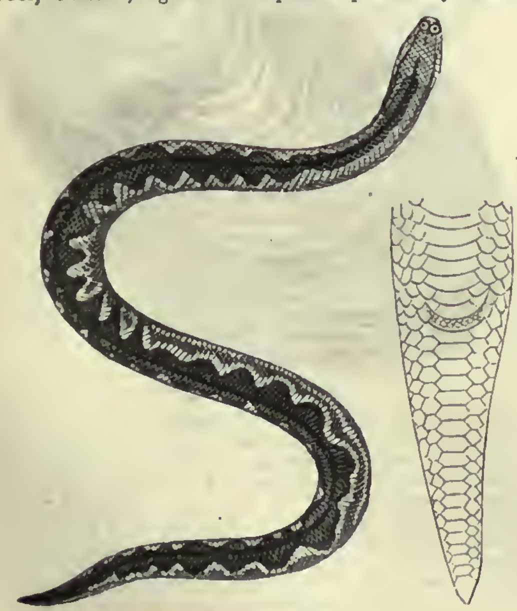
1 4 5 2 3

Erythroxylon laurifolium.

1, a calyx with the monadelphous stamens; 2, a petal with its appendage; 3, the ovary, with the three styles; 4, a half-ripe fruit; 5, a transverse section of the same, showing that one only of the seeds comes to perfection, the two others being abortive.

ERYTHROXYLON. [Coca.]

ERYX, or ERIX, a genus of Serpents separated by Daudin from *Boa*, and differing from it in having a very short obtuse tail, and the ventral plates narrower. The head of *Eryx* is short, and the characters geuerally would approximate the form to *Tortrix*, did not the conformatiou of the jaws place it at a distauce from the last-named genus. The head besides is covered with small scales only. *Eryx* has no hooks at the vent.



Eryx Bengalensis.

ESCALLONIA'CEÆ, *Escalloniads*, a small natural order of Exogenous Plants, related to the genus *Ribes*, in the opinion of some, but to that of *Saxifraga*, according to other botanists. It consists of shrubs with evergreen leaves, which ofteu emit a powerful odour like that of melilot; their flowers are red or white, and often are quasi-monopetalous, in consequence of the approximation of their petals. They have au inferior many-sceded ovary, with two large placentæ in the axis, a definite number of epigynous stamens, a single style, and minute chaffy seeds with a very small embryo lying in oily albumen. All the species inhabit South America, on the mountains, especially in alpine regions. *Escallonia rubra*, *E. Montevidensis*, *E. illinita*, and others, have now become common in warm sheltered gardens in this country.

2 1

Escallonia serrata.

1, a flower magnified, without the petals; 2, a transverse section of the ovary.

ESCHARA. [Polyzoa.]

ESCHSCHO'LTZIA, a genus of beautiful yellow-flowered Plants belonging to the natural order *Papaveraceæ*, inhabiting California and the north-western coast of North America, and now become extremely common in the gardens of Great Britain. They are known by the base of their calyx remaining at the base of the siliquose fruit in the form of a firm fleshy rim, by their calyx being thrown off like a calyptra when the petals unfold, and by the stamens being inserted iuto the edge of the permanent rim of the calyx. Otherwise they are very near our sea-shore *Glaucium*. Two certain species only, *E. Californica* and *E. crocea*, have yet becu introduced; a third, *E. compacta*, is figured in the 'Botanical Register,' but it is probably a mule between the first two. It has been recently proposed to alter this name, which has a barbarous sound and appearance, for the more harmonious one of *Chryseis*, and it is hardly to be doubted that the latter will be adopted. (*Botanical Register*, t. 1948.)

ESOX, a genus of Fishes established by Linnæus for the reception of the Pike and some allied forms. It is now subdivided, and the resulting genera, with the Flying-Fish (*Exocetus*), constitute the family *Esocidæ*. The genus *Esox*, as at present received, has for its type the *Esox Lucius* of Linnæus, tho Common Pike. The generic character is founded on the form and armature of the organs of mastication. The jaws, palatine bones, and vomer are furnished with teeth of various sizes. The head is oblong, obtuse, depressed, and large in proportion to the body. The dorsal fin is placed far back and over the anal. Both these fins are entire, which is also the caso in the genus *Belone*, of which the Gar-Fish is the type (*Esox Belone* of Liunæus); but in that fish the head and jaws are greatly produced, the latter being linear and pointed. *Scomberesox* (the Saury) is a third genus of this family, haviug a head resembling that of *Belone;* but the anal and dorsal fins are divided posteriorly into finlets resembling those of a mackerel. *Hemiramphus* is a curious genus of Sea-Pikes, in which the upper jaw is extremely short, while the lower one resembles that of the gar-fish. *Exocetus*, the Flying-Fish, was distinguished from *Esox* by Linnæus. [Exocetus.] It has tho head comparatively short, the dorsal and anal fins placed much farther forward, and the pectoral fins so large as to serve the purpose of wings, or rather of parachutes, which sustain the fish in the air for some time after it has sprung out of the water.

E. Lucius, the True, or Fresh-Water Pike, Pickerell, True Jack, or Gedd, is a well-known fish, esteemed for its food, and remarkable for its voracious and destructive habits. It is the longest-lived and largest of fresh-water fishes, and many wonderful stories are narrated of it. Gesner gives an accouut of one, the skeleton of which was preserved at Mannheim, which weighed 350 lbs., and was probably between 200 and 300 years old. Pennant informs us of one 90 years old; and pikes from 50 to 70 lbs. weight have been taken in Scotland and Ireland. It grows with great rapidity, attaining a length of from 8 to 10 inches in its first year. The Mannheim pike was said to have been 19 feet in length, and in our own country they have been taken 9 feet long. The Pike eats up everything eatable which comes in its way. Being strong, swift, and courageous, it masters all other fishes in its locality. It will also attack birds and small quadrupeds, if within reach, and has been known to quarrel with the otter for its prey, and to assault man himself. Pikes are found in Europe, Asia, and North America. In the United States there are several species of *Esox*.

The habits of the Sea-Pike, or Gar-Fish (*Belone vulgaris*), and the Saury (*Scomberesox*) are not so well known. They are gregarious, and swim near the surface of the water, leaping out of it with great agility, and playing round bodies which float on the surface of the sea. The peculiar formation of the heads of these fishes renders the nature of the food a subject of curiosity among naturalists; but the question is not yet settled. On the southern coasts of England and Ireland they are common. The bones of the *Belone* are green: the flesh is firm and white, and has much the flavour of that of the mackerel. [BELONE; SCOMBERESOX.]

ESSONITE. [GARNET.]

ESTRILDA, a genus of Birds belonging to the *Passerinæ*. The species are known by the name of Waxbills. They inhabit the Indian Archipelago and Australia.

ETÆ'RIO is a kind of fruit consisting of achenia, or small closed-up seed-like seed-vessels, placed upon a succulent receptacle. The strawberry and the raspberry are of this nature, and are very incorrectly called Berries, in the botanical sense of the word berry. [FRUIT.]

ETHE'RIA, Lamarck's name for a genus of Conchiferous *Mollusca*, placed by many authors among the *Chamidæ*, but separated by Deshayes and others. [CHAMACEA.]

Animal closely approximating to that of *Unio*. Lobes of the mantle disunited throughout their length, and consequently without either tubes or syphons. Below the foot the branchiæ of the right side unite themselves to those of the left side in the medial line, and leave below them a rather large canal, in which the vent terminates. The branchial leaflets are unequal, strongly striated and festooned on their free border. The mouth is rather large, and furnished on each side with a pair of palps like those of the *Uniones*. Finally (and, as Deshayes observes, it is a great singularity in an animal that lives attached to foreign substances), it is provided with a very large foot, which may be compared in regard of its form and position with that of *Unio*.

Shell adherent, thick, nacreous, very irregular, inequivalve, inequilateral; umbones short, thick, indistinct; hinge toothles, irregular, undulated, callous; ligament longitudinal, tortuous, external, penetrating pointedly into the interior of the shell; muscular impressions oval, irregular, one superior and posterior, the other inferior and anterior; pallial impression narrow and small.

M. Deshayes observes that on examining the shells of this genus, in which the ligament is not ruptured, it appears that the ligament is not entirely internal or subinternal, like that of the oysters, but that it has completely the structure of external ligaments. It is when the shells are young that the structure of the ligament is most easily recognised. There are two muscular impressions, always very distinct in old individuals; but in the young ones it sometimes happens that one only can be distinguished, and it was upon an individual in this state of growth that M. de Férussac established his genus *Mulleria*, which, in the opinion of M. Deshayes, cannot be retained. With regard to the crenulations on the hinge adverted to by M. de Férussac, M. Deshayes states that he had seen on the very individual which M. de Férussac had in his hands some small fractures resulting, as it appeared to M. Deshayes, from this cause, namely, that the shell having been taken with the animal, the valves had been separated by attacking the ligament with a sharp instrument.

Lamarck considered the genus *Etheria* to be marine, and accounted for its having escaped the notice of zoologists because it was attached to rocks at great depths in the sea. Mr. G. B. Sowerby, after noticing the locality attributed to the genus by Lamarck, remarks that two circumstances observable in the *Etheriæ* (*E. semilunata*), figured in his plate, would have induced him to suspect that this was a fresh-water shell, or at least an inhabitant of æstuaries at the mouths of rivers; 1st, its having an epidermis, which remains only in those parts least exposed to the action of the water, the greater part especially of the upper valve being eroded in a very irregular manner; and 2ndly, its being partly covered with the remains of those ovate vesicular bodies, supposed to be the eggs of some molluscous animals so frequently seen on fresh-water shells. M. Cailliaud was the first to make known the fact that the genus is an inhabitant of the fresh-waters, and M. de Férussac ('Mémoires de la Société d'Histoire Naturelle', vol. i.) published a paper on the subject from M. Cailliaud's materials, in which the former also made a revision of the species. M. Deshayes, in his treatise on the genus ('Encyclopédie Méthodique'), states that individuals of the same species adhere by the one or the other valve indifferently, which, he remarks, is not the case with the Oysters or the *Chamæ*. That *Etheria* may be attached indifferently by either valve there is no reason to doubt after the assertion of M. Deshayes; but Mr. Broderip ('Zool. Trans.,' vol. i.) observes that the same species of *Chama* is sometimes attached by the right, sometimes by the left valve. [CHAMACEA.] M. Rang, during a voyage to Senegal, made some interesting observations on *Etheriæ* which live two hundred leagues from the mouth of the river in the Senegal, and, together with M. Cailliaud, who received the animal from the Nile, published a memoir ('Mémoires du Muséum d'Histoire Naturelle') full of interest, in which the animal was described for the first time. The rivers of Africa and Madagascar appear to have afforded the specimens (which are still rather scarce in cabinets) hitherto collected. M. de Férussac, in his memoirs, gives the following information from M. Cailliaud.—"We first meet with *Etheriæ*," says that zealous traveller, "after passing the first cataract; and they do not appear to exist below; they become very abundant in the province of Rebata, beyond the peninsula of Meröe. The inhabitants collect them on the banks of the river to ornament their tombs with them, and they say that they come from the more elevated parts of the Nile, from Saïda, where they are eaten." M. Cailliaud found them as far as Fazoql, the most distant country into which he penetrated from the Blue River. In Sennaar the inhabitants informed M. Cailliaud, that during the summer season, when the river was low, they took them with the animal; but notwithstanding all his endeavours M. Cailliaud could not obtain any living specimens, the river being then always too high. They are said to be very common in the Jaboussi, a river which runs into the Blue Nile, and in all appearance the numerous confluent streams of this great arm of the Nile produce them also. The number found upon the tombs throughout Ethiopia is so great, that it is astonishing that Bruce and Burckhardt should not have mentioned them. ('Zool. Journ.,' vol. i.)

Etheria semilunata.

Lamarck recorded four species of *Etheria*, which he divided into two sections, each containing two species. The first of these consists of species which have an oblong callosity in the base of the shell; the second, of those which have no encrusted callosity at the base of the shell. These four species M. de Férussac (with justice, in the opinion of M. Deshayes) reduces to two; so that the sections, as left by Lamarck, would each, in that case, consist but of one species, namely, the first of *E. elliptica*, and the second of *E. semilunata*. M. Deshayes remarks that Lamarck saw but a very small number of individuals, and not being aware of their extreme variation, established species from the form of the shell; and it is certain, he adds, that if we were to follow the same indication at the present day, we might establish a species for each individual. He notices M. Rang's judicious observation, that in the same species there are individuals armed with spines, and others devoid of those appendages, and that the shades of this character are so gradual that it is impossible to regard it as of the smallest importance. In following out this principle, M. Rang considers *E. tubifera* of Sowerby and *E. Cailliaudi* of Férussac as identical, and *E. Corteroni* of Michelin to be the same as *E. plumbea* of Férussac. It is to the last-named species that M. Deshayes thinks that the genus *Mulleria* should be referred.

Etheria, or, as some write it, *Ætheria*, has not yet been discovered in a fossil state. It should be remembered that Rafinesque uses the term for a genus of Macrourous Crustaceans belonging to the *Palæmonidæ*.

ETHU'SA, a genus of Brachyurous Crustaceans (tribe Dorippians), established by M. Roux at the expense of the genus *Dorippe* of Fabricius and other naturalists.

M. Milne-Edwards observes that this genus is easily distinguished from *Dorippe* by the conformation of the apertures leading to the respiratory cavity, which here present the normal disposition.

Carapace nearly quadrilateral, but rather longer than it is wide, and very much flattened; front large, orbits directed forwards, very incomplete; eyes carried on a rather long and very projecting peduncle; they pass beyond the external angle of the carapace, and are not retractile. The internal antennæ are bent back (se reploient) forwards, in fossettes placed under the front; the external antennæ are rather long; their first joint is cylindrical, and separates the antennary fossette from the orbit; the third is longer than the second. The buccal frame (cadre buccal) is triangular, and reaches to the border of the antennary fossettes; the jaw-feet are much shorter, and leave naked the anterior portion of the jaw-feet of the first pair, which complete forwards the canal of the respiratory cavity; the third joint of the external jaw-feet is shorter than the second, nearly oval, sharply truncated forwards, and articulated with the following joint by the middle of its anterior border. The Pterygostomian regions are nearly quadrilateral, and are not prolonged between the base of the external jaw-foot and of the first thoracic foot, as in the Dorippes. The sternal plastron is oval. The anterior feet are short and slender in both sexes; in bending they form a double elbow, as in *Homola*. The succeeding feet are long, especially those of the third pair; those of the fourth pair are, on the contrary, extremely short, and inserted below the preceding; finally, the posterior feet, longer than the fourth pair, are inserted above and in front of them, and, like them, are terminated by a very short, hooked, and subcheliform tarsus. The abdomen in the male has seven distinct joints; in the female it has only five: the first two rings are directed backwards and on the same plane with the carapace.

Ex. *E. Mascarone* (Roux), *Cancer Mascarone* (Herbst).

Ethusa Mascarone.

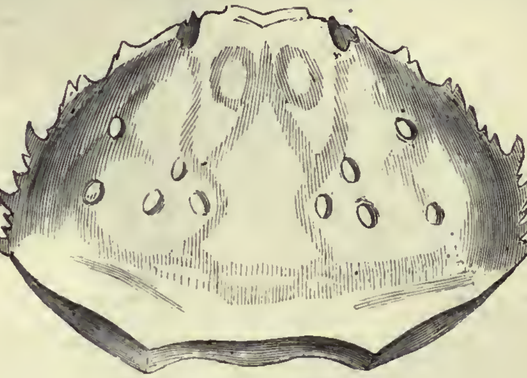
ETI'SUS, a genus of Brachyurous Crustaceans (Cancerians of M. Milne-Edwards).

Carapace less oval and wide than in most of the Arched Cancerians (Cancériens Arqués). The front is large, lamellar, and divided on the mesial line by a fissure, as in the *Xanthi*; but the two large and truncated lobes which form the principal part are separated by a deep notch of the anterior and superior angle of the orbit, which is rounded and projecting; the latero-anterior borders of the carapace are strongly toothed. The internal antennæ are bent back nearly longitudinally, and the basilary joint of the external antennæ, which is very large, unites with the front, and presents on the external side a prolongation which fills the hiatus of the internal orbital angle; finally, the moveable stem of these antennæ, which is very short, is inserted completely out of this hiatus, below the front and nearer to the antennary fossette than to the orbit. The external jaw-feet present nothing remarkable; the feet of the first pair are rather large, and the chelæ, which are much enlarged and rounded at the end, are deeply hollowed into a spoon-shape.

M. Milne-Edwards, who gives the above description, divides this small group, which he considers as forming the passage between the *Xanthi* and *Platycarcini*, into the two following sections:—

α. Carapace scarcely knobbed above.

Ex. *E. dentatus.* Length three or four inches; colour reddish. Locality, the Indian Archipelago.



Etisus dentatus.

β. Carapace covered with knobs, separated by deep furrows.

Ex. *E. anaglyptus.* Length about an inch and a half; colour whitish (?). Locality, Australia.

EUASTRUM. [DESMIDEÆ.]

EUCALY'PTUS, a genus of Australian Plants, consisting of lofty trees, with a volatile aromatic oily secretion in their leaves, and a large quantity of astringent resinous matter in their bark. They belong to the alternate-leaved division of *Myrtaceæ*, and are generically known among these plants by their corolla being absent, and the limb of their calyx consolidated into a hemispherical or conical cap, which is thrown off when the stamens expand.

This genus occurs in the Malayan Archipelago, but is chiefly Australian, and, together with the leafless Acacias, gives a most remarkable character to the scenery. The species exist in great profusion, and form the largest trees in the forests of that part of the world. A modern writer upon the plants of Van Diemen's Land says that *Eucalyptus* seems as if it had taken undisturbed possession of those Australian regions, clothing as it does with a stupendous mantle the surface both of Van Diemen's Land and Australia; while the intermixture of other plants which this lordly tribe permits is, compared with its own great extent, but small and partial. Wherever you go, one species or other is constantly before you.

No trees in the world so constantly or rapidly arrive at gigantic dimensions: they often become hollow, and are then used by the traveller as roomy places of shelter at night. Frazer found a hollow *Eucalyptus* at Moreton Bay, used by the natives as a cemetery. Even at Swan River, where, according to the report of Frazer, the species are stunted, they also attain a huge size. *E. calophylla* attains a height of 150 feet, and a girth of from 25 to 50 feet is not an uncommon dimension of these trees. Their timber is represented as highly useful for domestic and other purposes; being so soft at first as to render the felling, splitting, and sawing up of the tree, when green, a very easy process, and when thoroughly dry becoming as hard as oak.

E. resinifera has leaves with very minute and numerous little dots, ovate-lanceolate, with long tapering points narrowed to the base, with a vein next the margin. The flowers are umbellate, on a compressed peduncle rather longer than the petiole. The lid is conical, taper, leathery, twice as long as the capsule. The bark is so extremely astringent as to yield a gum not inferior to Kino, and sold as such. The bark of this and other species is so hard as to cause them to be called Iron-Bark Trees by the colonists. The Blue Gum-Tree and some others have the singular property of throwing it off in white or gray longitudinal strips or ribands, which, hanging down from the branches, have a singular effect in the woods.

In many species the leaves are so variable in their form and other characters at different ages of the tree, or in different situations, that it is a matter of difficulty to know how they are to be botanically distinguished from each other; and in fact the subject of the distinction of species has hardly yet been taken up, no botanist feeling competent to undertake the task without some personal acquaintance with the plants in a native state. The leaves, instead of presenting one of their surfaces to the sky and the other to the earth, as is the case with the trees of Europe, are often arranged with their faces vertical, so that each side is equally exposed to the light.

E. robusta contains large cavities in its stem between the annual concentric circles of wood, filled with a most beautiful red or rich vermilion-coloured gum, which flows out as soon as the saw affords an opening.

E. mannifera exudes a saccharine mucous substance resembling manna in its action and appearance, but less nauseous. It is not produced by insects, and only appears in the dry season. Other species yield a similar secretion at Moreton Bay and in Van Diemen's Land. Mr. Backhouse says it coagulates, and drops from the leaves in particles often as large as an almond.

E. Gunnii, when wounded, furnishes the inhabitants of Van Diemen's Land with a copious supply of a cool, refreshing, slightly aperient liquid, which ferments and acquires the properties of beer.

Upon the whole this genus must be considered the most important that Australia produces. As it occurs so far to the south as Van Diemen's Land it is almost certain that it might be naturalised in Devonshire, Cornwall, and in the west of Ireland. Even in the neighbourhood of London certain kinds bear moderate winters without shelter, especially *E. pulverulenta*.

It is very much to be regretted that some settled nomenclature is not introduced, for the colonists apply the same names to different species in different parts of the country; this renders it difficult to tell of what they are speaking. As far as we can collect the evidence, it appears that the following are, or should be the botanical species to which the colonial names belong:—

Blue Gum of Port Jackson	*E. piperita.*
Blue Gum of Hobart Town	*E. globulus.*
Stringy Bark	*E. robusta.*
Iron-Bark	*E. resinifera.*
Kino-Gum	*E. resinifera.*
Peppermint-Tree	*E. piperita.*
Weeping Gum of Van Diemen's Land	Uncertain.
Mountain Blue Gum of Van Diemen's Land	Uncertain.
Black Gum of Van Diemen's Land	Uncertain.
Black-Budded Gum of Van Diemen's Land	Uncertain.
Cider-Tree of Van Diemen's Land	Uncertain.
Manna-Gum	Uncertain.
Manna of Moreton Bay	*E. manna*, Cunn.
Blood-Wood of Port Jackson	*E. corymbosa.*
White Gum of Van Diemen's Land	*E. resinifera.*
White Gum of Moreton Bay	*E. subulata*, Cunn.
White Gum of the S.W. Interior	*E. Leucadendron*, Cunn.

EUCHARIS. [Acalephæ.]

EUCHROITE, a Mineral consisting of Arseniate of Copper. It occurs crystallised. Its primary form is a right rhombic prism. Cleavage indistinct. Colour bright emerald-green. Streak pale apple-green. The fracture is uneven. Hardness 3·5 to 4·0. Lustre vitreous. Refraction double. It is transparent, translucent. Specific gravity 3·38 to 3·41. Found at Libethen in Hungary. The analysis, by Turner, gives—

Arsenic Acid	33·02
Oxide of Copper	47·85
Water	18·80
	99·67

EUCHYSIDERITE (*Achmite*), a Mineral which occurs crystallised. Primary form an oblique rhombic prism, of same cleavage and measurements as Pyroxene. Colour brownish-black. Lustre vitreous. Nearly opaque. Specific gravity 3·34. Hardness 6·0 to 6·5. Streak yellowish-gray. Fracture imperfect, conchoidal. It occurs in Norway. Before the blow-pipe alone readily fuses into a brilliant black globule; with borax forms a coloured glass.

According to Berzelius it consists of—

Silica	55·25
Oxide of Iron	31·25
Soda	10·40
Lime	0·72
Oxide of Manganese	1·08
	98·70

EUCLASE, a crystallised Mineral, the primary form of which is an oblique rhombic prism. It is either colourless and nearly transparent, blue, or pale bluish-green. It refracts doubly. Lustre vitreous. Hardness 7·5. Specific gravity 3·098. Cleavage very distinct, parallel to the oblique diagonal, but indistinct parallel to the terminal plane and horizontal diagonal. The fracture is uneven, and the streak white. It was first found in Peru, but has since been met with in detached crystals in alluvial ground in Brazil.

According to Berzelius it consists of—

Glucina	21·78
Silica	43·32
Alumina	30·56
Oxide of Iron	2·22
Oxide of Tin	0·70
	98·58

EUCNEMIS. [Elateridæ.]

EUCŒLIUM. [Synoicum.]

EUDEA. [Spongiadæ.]

EUDENDRIUM, a genus of Zoophytes belonging to the family *Tubularidæ*. There are two British species, *E. rameum* and *E. ramosum*. [Tubularidæ.]

EUDIALYTE, a Mineral which occurs both crystallised and massive. The crystals are generally small. The primary form is a rhomboid; the colour is red or brownish-red, and the crystals are faintly translucent or opaque. Lustre vitreous, sometimes dull. Specific gravity 2·9. Hardness 5·0 to 5·5. Streak white. Fracture uneven. The massive varieties are imbedded and amorphous. It occurs at Kandarluarsuk, in West Greenland. Before the blow-pipe it fuses into a leek-green scoria.

According to Stromeyer it consists of—

Silica	52·47
Zirconia	10·89
Lime	10·14
Soda	13·92
Oxide of Iron	6·85
Oxide of Manganese	2·57
Muriatic Acid	1·03
Water	1·80
	99·67

EUDORA. [Acalephæ.]

EUDYNAMIS. [Cuculidæ.]

EUDYTES. [Colymbidæ.]

EUGENESITE. [Palladium.]

EUGE'NIA, a genus of Dicotyledonous Polypetalous Plants of the natural order *Myrtaceæ*, so named in honour of Prince Eugene of Savoy, who was a patron of botany and horticulture. The genus, as at present constituted, contains nearly 200 species, though numbers have been removed to the genera *Nelitris*, *Jossinia*, *Myrcia*, *Sizygium*, *Caryophyllus*, and *Jambosa*, in which are now contained the Clove-Tree, the Rose-Apple, and Jamoon of India, formerly included in *Eugenia*. This genus is confined to the hot and tropical parts of the world, as Brazil, the West India Islands, and Sierra Leone, and extends from the Moluccas and Ceylon to Silhet and the foot of the Himalayas in Asia.

Eugenia is characterised by having the tube of the calyx of a roundish form, and the limb divided into four parts; the petals equal in number, and inserted on the calyx. The stamens are numerous. The ovary 2-3-celled, with several ovules in each. Seeds 1 or 2, roundish, and large, with the cotyledons and radicle united into one mass. In habit and inflorescence the species resemble many myrtles. Like the family to which they belong, some of the species of *Eugenia* secrete a warm volatile oil in their herbaceous parts; abound in tannin; yield good wood; and a few have fruit which is edible, though not very agreeable, from being impregnated with the aroma of the oil.

Eugenia Pimenta, the Allspice Pimento, or Bayberry-Tree, is a native of South America and the West India Islands, especially Jamaica, and from being cultivated there is often called Jamaica Pepper. The tree is very handsome, often 30 feet high, and much resembles the Clove-Tree in the form and appearance of its leaves, as well as in habit. The trunk is smooth, and much branched towards the top. The older branches are round, the younger compressed, and the twigs as well as the flower-stalks pubescent; the leaves are petiolate, oblong or oval, smooth, and marked with pellucid dots, forming a dense evergreen foliage; the flower-stalks are both axillary and terminal, and are divided into 3-forked panicles; the flowers are small, without show, and conformable in structure to the character of the genus. The berry is spherical and crowned with the persistent calyx; when ripe, smooth, shining, and of a dark purple colour; usually 1-celled, occasionally 2-celled, containing large roundish seeds.

The *Pimenta* is cultivated with great care in Jamaica, and abounds especially on the hills on the north side of the island. The trees are formed into regular walks, and begin to bear when three years old, but are not in perfection until they have been planted seven years. They thrive best in rocky lands, or a rich soil having a gravelly bottom. Mr. Bryan Edwards says that a single tree has been known to yield 150 lbs. of the raw fruit, or 100 lbs. of the dried spice; but the crop is uncertain, and plenteous perhaps only once in five years. The tree has been introduced into and flourishes in the southern parts of India.

The berries, being the valuable part of the tree, require care in gathering as well as drying; the processes for which are described by Browne in his 'History of Jamaica,' p. 248. They must be picked when they have arrived at full growth, but before they begin to ripen; they are dried in the sun, on raised boarded floors, and frequently turned during the first and second day; they are then put into sheets, often winnowed, and exposed to the sun until sufficiently dried, which is known by the colour and the rattling of the seeds in the berries. Browne says, "Such of the berries as come to full maturity do, like many other seeds, lose that aromatic warmth for which they are esteemed, and acquire a taste perfectly like that of Juniper Berries, which renders them a very agreeable food for the birds, the most industrious planters of these trees."

The leaves and bark participate in the warm aromatic properties for which the berries are celebrated, and which have received their name of Allspice from their fragrant odour being thought to resemble that of a mixture of cinnamon, cloves, and nutmeg. Their taste being warm and aromatic makes them useful as a spice in cookery, and a stimulant in medicine.

Eugenia Michelii is a Brazilian species, cultivated in Martinique, whence it is called Cerisier de Cayenne, as it yields a small edible fruit.

E. acris, Wild Clove, is a native of the West India Islands. It is arborescent and glabrous; the young branches acutely 4-angled, the leaves elliptic oval, obtuse, more or less convex coriaceous, very glabrous, the upper side reticulated with elevated veins, finely pellucid, dotted; the peduncles are compressed, axillary, and terminal, trichotomous, corymbose, rather longer than the leaves. The calyx-limb 5-partite; segments roundish, the style filiform, acute, the berry globose, 1-4 seeded. This species is sometimes confounded with the former species, in whose qualities it participates. *E. cauliflora*, the Jabuticaba or Jaboticaburas, is one of the most agreeable fruits in Brazil, and the taste will be improved by future culture. Very good wine, syrup, &c., are made of it. *E. dysenteria*, *E. Michellii*, and *E. Brasiliensis*, called respectively Aracea, Pitanga, Grumixameira, Cambuy, Uvaltra, Pitangueira, &c., are all spoken of by Martius as excellent dessert fruits. The Rose-Apples of the East are produced by species of this genus.

EUGENIACRINITES (Goldfuss), a genus of Fossil *Crinoidea*. [ENCRINITES.]

EU'GNATHUS, a genus of Fossil Pacoid Fishes, from the Lias, of which there are thirteen British species. (Agassiz.)

EUKAIRITE, a Mineral consisting of seleniuret of silver and copper, discovered by Berzelius. It occurs in thin films of a shining lead colour; opaque; its texture is granular. It yields readily to the knife, and acquires a silvery lustre. It occurs in a copper mine in Sweden. Before the blow-pipe it exhales a strong smell of selenium; and with charcoal fuses into a brittle metallic globule. It consists of—

Selenium	26
Silver	38·93
Copper	23·05
Earthy Matter	8·90
Carbonic Acid and loss	3·12
	100

EULABES. [CORACIAS.]

EULA'LIA, a genus established by Savigny, and placed by Cuvier among his Dorsibranchiate Annelides.

EU'LIMA, a genus of marine Gasteropodous *Mollusca*, established by M. Risso.

Shell turreted, acuminated, polished, with many whorls; aperture ovate, acuminated posteriorly; external lip thickened, generally forming numerous obsolete varices. Operculum horny, thin, its nucleus anterior.

Mr. G. B. Sowerby, who gives this generic character, says ('Zool. Proc.,' 1834) that this genus of marine shells appears to be most nearly related to *Pyramidella* and *Rissoa*. A species, he adds, which has been long known has had the appellation of *Turbo politus* among British Linnean writers; and a fossil species has been placed by Lamarck among the *Bulini*, under the specific name of *B. terebellatus*. Mr. Sowerby separates the genus into the two divisions below stated, which are characterised by the two species above mentioned; one has a solid columella, and the other is deeply umbilicated. All the species, he observes, are remarkable for a brilliant polish externally, and the shells are frequently slightly and somewhat irregularly twisted, apparently in consequence of the very obsolete varices following each other in an irregular line, principally on one side, from the apex towards the aperture. He describes sixteen species, chiefly from Mr. Cuming's collection.

The geographical distribution of this genus is wide; they have been principally found, as yet, in warm seas (South and Central America and Pacific Ocean, Australia). Messrs. Forbes and Hanley record four British species *E. polita*, *E. distorta*, *E. subulata*, and *E. trilineata*.

The species found by Mr. Cuming were dredged or otherwise collected in sandy mud, coarse sand, and coral sand, on mother-of-pearl shells, or on the reefs; at depths (not including the reefs) ranging from six to thirteen fathoms.

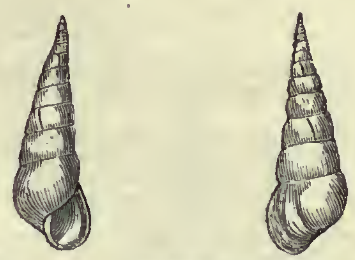
α. Perforated *Eulimæ*.

E. splendidula. Shell acuminate-pyramidal, brownish, articulated with white and chestnut near the sutures; umbilicus large; aperture angulated anteriorly. Length 1·45, breadth 0·6 inches. Locality, St. Elena, South America. Mr. Cuming dredged a single specimen in sandy mud at from six to eight fathoms depth.

Eulima splendidula.

β. Imperforated *Eulimæ*.

E. major. Shell acuminate-pyramidal, opaque, milk-white; external lip subarcuated. Length 1·6 inches, breadth 0·4. Locality, the Island of Tahiti. The largest specimen was found in coral sand on the reefs.



Eulima major.

Fossil species are found in the Calcaire Grossier near Paris.

EULIMELLA, a genus of *Mollusca* belonging to the family *Pyramellida*, founded by E. Forbes, to receive forms that had been previously referred to *Eulima* and *Odostomia*. The shell is elongated, and consists of many whorls, solid, smooth, and polished; the apex of the spine has a persistent embryonic sinistral shell; the aperture subquadrate; peristome imcomplete; columella not plicated, straight or nearly so; operculum corneous, pyrifom. There are four British species. *E. scillæ* (*Eulima crassula*, Jeffreys), *E. acicula* (*Melania acicula*, Philippi), *E. affinis* (*Eulima affinis*, Philippi), *E. clavula* (*Turbinella clavula*, Loven).

EULO'PHIA (from εὖ, and λόφος, a crest), a genus of Plants belonging to the natural order *Orchidaceæ*. It has an open spreading perianth; the sepals and petals ascending, nearly equal, either quite distinct, or united with the more or less lengthened base of the column; the lip horned or shortly spurred, sessile, with the veins crested, bearded, or quite smooth, usually 3-lobed, sometimes undivided; the column half-terete, edged; the anther terminal, opercular; the pollen masses 2, waxy, 2-lobed, or hollowed out at the back, with a short linear caudicula, and a transverse gland. The species are terrestrial plants, with pseudo-bulbous rhizomata, long membranous plaited leaves, and radical many-flowered scapes. Most of the rhizomata and roots of the species of the family *Orchidaceæ* yield starch in a peculiar form. The roots of the species of *Orchis* are used in Europe under the name of Salep as an article of diet, and the same use is made of the rhizomata of a species of *Eulophia* in the East Indies. Although specimens of the plant were brought from Cashmere by Dr. Royle, they were not in a state of preservation to be identified. (Lindley, *Flora Medica*.)

EULYMENE. [ACALEPHÆ.]

EUME'DONUS, a genus of Brachyurous Crustaceans, the first of the Parthenopians of M. Milne-Edwards, and which in his opinion establish in some sort the passage between the *Stenorhynchi*, *Achæus*, on the one side, and *Eurynome*, *Lambrus*, and *Parthenope* on the other. The form of the carapace is nearly pentagonal as in the latter, but it is at the same time thrown forwards, as it were, and scarcely overpasses the line of the feet of the hind pair of limbs—a disposition which recalls the construction of the former. The body is depressed; the rostrum, which is very large and projecting, is only divided towards its extremity; the eyes are very short, and their peduncle entirely fills the orbits, which are circular—a character which again approximates these crustaceans to the *Stenorhynchi*; the internal antennæ are folded back very obliquely outwards, and the external antennæ are but little developed. The epistome is shorter than in the majority of the *Oxyrhynchi*. The external jaw-feet present nothing remarkable. In the male the thoracic feet of the first pair are large, and much longer than the rest; all these are a little compressed, and their third joint is surmounted by a crest, which is not distinctly perceptible on the other joints; the feet of the second pair are rather shorter than those of the third and fifth pair, which are nearly as long as the fourth. The abdomen of the male is composed of seven articulations.

E. niger. This small species, the only one known, is of a bronzed black colour, and inhabits the coasts of China.

EUMORPHUS, a genus of Coleopterous Insects belonging to the section *Trimeri* of Latreille, and being the typical genus of the family *Fungicolæ*. These insects are characterised by having the antennæ longer than the head and thorax, the body oval, and the thorax irregularly square; the maxillary palpi filiform, or slightly thickened at the end, but not terminated by a large process as in some genera: the last joint of the tarsus is always deeply divided into two lobes.

Latreille ('Règne Animal') divides the genus *Eumorphus* into several sub-genera. Some of the species have the third joint of the antennæ much longer than any of the other joints; these form the genus *Eumorphus* (proper), in which the antennæ are club-shaped. All the species are natives of America or the East Indies. Ex. *Eumorphus immarginatus*. (Latr., 'Gener. Crust. et Insect.,' tab. xi. fig. 12.)

Second Sub-Genus, *Dapsus* (Ziég.). Some of the species have the antennæ club-shaped as in *Eumorphus* proper, but straighter and more elongated, and with the joints bent laterally: among these *Eumorphus Kirbyanus* (Latr.) is now placed. In other species of *Dapsus* the third joint of the antennæ is not longer than any of the others. Many of the species of *Dapsus* are indigenous in Europe, living in different *Fungi*, whence the name of the family (*Fungicolæ*). Some of these insects are also found under the bark of the birch and other trees.

Third Sub-Genus, *Endomychus* (Fab.), has the three last joints of the antennæ bent laterally, larger than the others, and forming a triangular club-shaped mass.

Fourth Sub-Genus, *Lycoperdina* (Latr.), has the maxillary palpi filiform, and the last joints of the labia are enlarged. [TRIMERI.]

EUNICE, a genus of Dorsibranchiate *Annelida*. It is furnished with tuft-like gills; the trunk is armed with three pairs of horny jaws; each of the feet has two cirri and a bundle of bristles; two tentacles upon the head above the mouth, and two on the neck.

E. gigantea is the largest Annelide known. It attains a length of from one to four feet, and inhabits the sea around the Antilles.

EUO'MPHALUS, a genus of fossil *Gasteropoda*, from the Palæozoic Strata. (Sowerby.) [TROCHIDÆ.]

EUO'NYMUS (*εὐώνυμος*, literally 'having a good name,' and hence various derived senses), a genus of Plants belonging to the natural order *Celastraceæ*. It has a flat 4-5-lobed calyx with a peltate disc at the base; 4-5 petals, inserted in the margin of the disc; 4-5 stamens, inserted in the disc; a single style; the capsule 3-5-celled, 3-5-angled, the dehiscence loculicidal; the seed solitary, with a fleshy arillus, not truncate at the hilum. The species are shrubs with tetragonal or terete branches, and ovate usually opposite leaves, yielding a fetid odour when bruised, and considered poisonous.

E. Europæus, Spindle-Tree, has the petals oblong; the flowers mostly 4-cleft and tetrandrous; the branches tetragonal, smooth, and even; the leaves elliptic-lanceolate, minutely serrate; the capsule obtusely angular, not winged. It is a native of Europe in hedges and thickets, and is found abundantly in Great Britain. The flowers are small, of a greenish-white colour, and give out a fetid odour. Its wood is tough and white, and is used for making skewers. It has from this got the name of Prick-Wood; Gerard calls it Prick-Timber. Its French name is Fusain, in allusion to its use in making spindles. It is called also in French Bonnet de Prêtre and Bois à Lardoire; the former in allusion to the capsules, which when open bear some resemblance to a priest's cap, the latter from the use made of the wood in making skewers and larding-pins. It has, in common with the *Cornus sanguinea*, the names of Dog-Wood and Gatteridge-Tree; the first name is in allusion to the use of the wood of these trees for making an infusion with which mangy dogs were washed. It is also known in English by the name of Louse-Berry, a name which it has got from its berries being used when powdered as an application to the head for the destruction of lice. The wood of this tree is also used by musical instrument makers. When used for skewers, toothpicks, &c., the branches are cut when the shrub is in blossom, as that is the period when the wood is toughest. Linnæus says that cows, goats, and sheep eat the leaves, but that horses refuse them. The berries are poisonous, and produce when eaten vomiting and purging. Whilst growing wild in hedges and coppices this plant does not attain any great size; but when planted and allowed to grow alone it becomes a tree, and reaches a height of twenty or thirty feet. Although almost entirely neglected in the planting of pleasure-gardens, it forms a singularly beautiful object in the autumn, when its clusters of red berries are ripe. The seeds are covered with an arillus, which is of a beautiful orange colour.

E. verrucosus has the branches warted with proximate lenticular glands; the leaves ovate and slightly serrate; the flowers 3 on a peduncle; the petals ovate; the capsule bluntly 4-cornered. This is a deciduous shrub or low tree, a native of Austria, Hungary, and Carniola. It has a singular appearance, and is worthy of cultivation on that account amongst collections.

E. latifolius has smooth branches; broad ovate leaves; trichotomous many-flowered peduncles; oval obtuse petals; the lobes of the capsule acutely angular and wing-formed. It is a deciduous shrub or low tree, attaining a height of 10-20 feet, and is a native of the south of Europe. Its fruit is large, and of a deep red colour; the decaying leaves are also reddish. This is the handsomest species of the genus. It has broad shining leaves, and its large red pendulous fruits, with their orange-coloured seeds, which are suspended in the air when the capsules open, contribute much to the beautiful appearance of this tree.

E. Americanus, American Spindle-Tree, has smooth branches; the leaves almost sessile, elliptic-lanceolate, serrated; the flowers 1 to 3 on a peduncle; the petal sub orbiculate; the capsules warty. This is a sub-evergreen recumbent shrub, and is a native of North America from Canada to Florida. The capsules are of a deep crimson, the seeds white, and the arillus scarlet. They add much to the beauty of this plant, and have given rise in America to its common name, the Burning Bush. It is of easy culture in a moist soil. Several varieties have been described by botanists. *E. atropurpureus* is found in English gardens, and is a native of America. *E. Hamiltonianus* is a Nepaul species, introduced about twenty years ago. *E. nanus* is a dwarf species.

About thirty species have been described. All the hardy kinds are easily cultivated in any common soil in the open air. They may be propagated by seeds which ripen in this country. Cuttings planted in the autumn will readily take root.

(Loudon, *Encyclopædia of Trees and Shrubs*; Don, *Dichlamydeous Plants*.)

EUPATORIA'CEÆ, one of the tribes of composite plants admitted by De Candolle, who defines it thus:—"Style of the hermaphrodite flowers cylindrical; the arms long, somewhat clavate, covered externally with downy papillæ at the upper end. The stigmatic series but little prominent, and usually disappearing before they reach the middle of the arms of the style." Under this character are arranged 38 genera, the most extensive of which is the genus *Eupatorium*, including no fewer than 294 species.

EUPATO'RIUM, a genus of Plants belonging to the natural order *Compositæ*, the tribe *Eupatoriaceæ*, the sub-tribe *Eupatorieæ*, and the division *Adenostyleæ*. It has 3-100-flowered heads, a flat naked receptacle, the scales of the involucre in one or two or more rows, equal or unequal, loosely or closely imbricated, the throat of the corolla hardly dilated, the anthers inclosed, the arms of the style exserted, cylindrical, obtuse; the pappus in one row, hairy, rough.

E. cannabinum, Hemp-Agrimony, has the leaves in 3 or 5 deep lanceolate serrated segments, the middle one longest. It is a native of Europe, and is mostly found on the banks of streams. It is a common plant in the British Isles. The stem is about three feet high, and has a slightly aromatic smell. The whole plant is bitter, and was formerly employed in medicine as a tonic and febrifuge. An infusion of this plant is said to be the common medicine of the turf-diggers in Holland against the ulcerations and diseases of the feet and legs to which they are subject. The expressed juice, when taken in large quantities, produces both vomiting and purging.

E. perfoliatum, Thorough-Wort, Thorough-Wax, Cross-Wort, or Bone-Set, has subsessile opposite linear-lanceolate acuminate leaves, decreasing gradually in breadth from the stem, where they are widest, to the extremities; serrated, wrinkled, pale underneath, and hairy, especially the veins. This plant is a native of North America, in meadows and boggy soils. It has erect round hairy stems, branched only at the top, with a cylindrical imbricated involucre, inclosing from 12 to 15 flowers, the florets of which are tubular. All parts of this plant are intensely bitter, and a decoction of the leaves has been recommended by American physicians as a valuable tonic and stimulant, and used as a substitute for Peruvian bark in the cure of intermittent fever. In large doses the infusion or decoction of the whole plant is emetic, sudorific, and aperient. It is used with advantage instead of the infusion of chamomile flowers in working off emetics.

E. Ayapana has subsessile, opposite, lanceolate, triple-nerved, acuminate, nearly entire, smooth leaves. It is originally a native of South America, on the right bank of the river Amazonas, whence it has been introduced into the East Indies. It has a stem shrubby at the base, branched, and smooth; the heads are pedicellate, and contain about 20 florets. An infusion of this plant is used in Brazil as a diuretic and diaphoretic. It has also been employed as an antidote against the bites of venomous serpents and insects. A quantity of the bruised leaves is laid upon the scarified wound, and the fresh juice is administered from time to time to the patient. The reputation of this plant for the bites of poisonous serpents, like that of many others, is probably undeserved. Other species of *Eupatorium* possess medicinal properties: *E. aromaticum* and *E. odoratum* have very fragrant roots; *E. perfoliatum* and *E. rotundifolium* have been employed in renal diseases and consumption. The *E. Guaco* of older botanists is now referred to the genus *Mikania*. [MIKANIA.]

(Burnett, *Outlines of Botany*; Lindley, *Flora Medica*; Lewis, *History of Materia Medica*.)

EUPHEUS. [ISOPODA.]

EUPHO'RBIA, a genus of Exogenous Plants, giving its name to an extensive and important natural order. It has very small monandrous naked male flowers, crowded round an equally naked female one, in the inside of an involucre looking like a calyx, and formerly mistaken for that organ. The species have either a common leafy appearance, with the involucres proceeding from among large foliaceous bracts, or they are nearly leafless, with their stem excessively succulent, so as to resemble *Cacti*. Those with the former character are natives of most parts of the world, and are the only kinds found in Europe; the succulent species chiefly appear in the hottest and driest countries. Barren uncultivated places in the plains of Hindustan, and the arid regions of Asia and the north of Africa are their favourite stations; in the Canaries, on volcanic soil, *E. Canariensis* and *E. laphylla* form great bushes with arms like candelabras. From *Cacti*, which some of these plants much resemble, they are readily known by their spines, when they have any, not growing in clusters, and by their emitting, when punctured, an abundant discharge of milky juice. This, in a concrete state, forms what is called the gum-resin, or rather resin, called *Euphorbium*, an acrid, corrosive most dangerous drug, principally furnished by

E. officinarum, *E. antiquorum*, and *E. Canariensis*. The same properties exist in the herbaceous leafy species, diffused in some, concentrated in others.

Euphorbia officinarum.

E. Lathyris, a common weed in cottage gardens, where it is called Caper, yields from its seeds an oil of the most violent purgative nature. If it were less dangerous it might be substituted for Tiglium oil. Fée states that with as much of this oil as could be sold for a franc ninety adults might be purged.

E. Tirucalli has erect naked round branches, which are succulent, polished, and abounding in milky juice. The leaves are small, linear, fleshy, sessile, and at the ends of the twigs. The flowers are crowded, sub-sessile, terminal, and axillary; the lobes of the involucre are five in number, roundish, smooth, and peltate; the tube woolly on the inside. The capsule is villous. The milk when introduced into the eye produces severe inflammation and even blindness. It is used medicinally in India.

E. tribuloides has a stem about two inches high and one inch broad, ovate, fleshy, quadrangular, having two opposite, stalked, ovate spathulate leaves growing from its base. The prickles are in pairs, white, clustered on the margin of the angles. It is said to be a sudorific.

E. antiquorum is common on barren and uncultivated lands all over India and Arabia Felix. It has a shrubby leafless succulent stem. The branches are spreading, triangular or quadrangular, the angles sinuated, and armed with double spines at the protuberances. The peduncles are solitary or in pairs, 3-flowered. There are only 5 stamens. The bark of the root when bruised in water is taken as a purgative. Some writers consider that this plant yields the drug *Euphorbium*, a resinous substance possessing acrid irritant properties. In all probability however this substance is chiefly obtained from *E. officinarum*. The Arabs make up violent diuretic pills by rubbing over the juice of *E. antiquorum* with flour, yet their camels will eat the branches when cooked. The juice of *E. heptagona*, *E. virosa*, and *E. cereiformis*, African species, furnishes the Ethiopians, and *E. cotinifolia*, the wild Brazilian, with a mortal poison for their arrows. The juice of the leaves of *E. nereifolia* is prescribed by the native practitioners of India internally as a purge and deobstruent, and externally, mixed with Margosa oil, in such cases of contracted limb as are induced by rheumatic affections. The leaves have no doubt a diuretic quality. Of the leafy Euphorbias great numbers are found to possess a milk with purgative or emetic qualities. The roots of some of the species are emetic.

According to Deslongchamps the powdered root of *E. Gerardiana* is emetic in doses of 18 or 20 grains. The root of *E. Ipecacuanha* is said by Barton to be equal to the true Ipecacuanha—in some respects superior. *E. Pithyusa* is esteemed in the Mediterranean. *E. thymifolia* is somewhat aromatic and astringent, and is prescribed in India in the diarrhœa of children, and as a vermifuge. In the same way is employed *E. hypericifolia*, a plant of tropical America, which is astringent and somewhat narcotic. Nevertheless, *E. balsamifera* has no such qualities, and is eaten when cooked. *E. Mauritanica* is also employed as a condiment; but its acridity is unpleasant. It is said to be used in adulterating scammony. The sap of *E. phosphorea* shines with a phosphorescent light in a warm night in the ancient forests of Brazil. (Lindley, *Vegetable Kingdom.*)

EUPHORBIACEÆ, *Spurgeworts*, a natural order of Exogenous Plants with definite suspended anatropal ovules, scattered flowers, and tricoccous fruit. The genera consist of trees, shrubs, or herbaceous plants, often abounding in acrid milk. The leaves are mostly opposite or alternate, simple, rarely compound, often with stipules. The flowers are axillary or terminal, arranged in various ways, sometimes inclosed within an involucre resembling a calyx; flowers monœcious and diœcious. The calyx inferior, with various glandular or scaly internal appendages (sometimes wanting). Corolla either consisting of petals or scales, equal in number to the sepals, or absent, or sometimes more numerous than the sepals; sometimes monopetalous. The stamens definite or indefinite, distinct, or monadelphous; anthers 2-celled, sometimes opening by pores. Ovary free, sessile, or stalked, 1-2-3- or more celled; ovules solitary or twin, suspended from the inner angle of the cell; styles equal in number to the cells, sometimes distinct, sometimes combined. Fruit generally tricoccous, consisting of three carpels splitting and separating with elasticity from their common axis, occasionally fleshy and indehiscent.

Andrachne telephioides.

1, a male flower; 2, a female flower; 3, an ovary nearly ripe; 4, a section of a ripe fruit.

This extensive order, which probably does not contain fewer than 2800 species, described or undescribed, exists in the greatest abundance in equinoctial America, where about three-eighths of the whole number have been found, sometimes as large trees, frequently as deformed bushes, still more usually as diminutive weeds, and occasionally as leafless succulent plants resembling Indian figs in aspect, but not in any other particular. In the Western World they gradually diminish as they recede from the equator, so that not above 50 species are known in North America, of which a very small number reaches as far as Canada. In the Old World the known tropical proportion is much smaller, arising probably from the species of India and equinoctial Africa not having been described with the same care as those of America, not above an eighth having been found in tropical Africa, including the islands; a sixth is about the proportion in India. A good many species inhabit the Cape, where, and in the north of Africa, they often assume a succulent habit; and there are about 120 species from Europe, including the basin of the Mediterranean, of which 16 are found in Great Britain, and 7 in Sweden. A large number of these plants are poisonous. The poisonous principle resides chiefly in their milky secretion. The hairs of some are stinging. The bark of many is aromatic; and the flowers of some tonic. Many are used in medicine, such as *Croton*, *Cascarilla*, and *Euphorbia*. The stimulating poisonous principle however appears to be volatile, since the action of heat is sufficient to dispel it. Thus the starchy root of the Manihot, or Cassava, which when raw is a violent poison, becomes a wholesome nutritious food when roasted. Some yield a fixed oil from their seeds, as the species of *Elæococca*. For further particulars respecting the important and various properties of the species of this order, see PEDILANTHUS, CROTON, BUXUS, CASCARILLA, JATROPHA, RICINUS, and EUPHORBIA. The order contains 191 genera, and 2800 species.

EUPHOTIDE, a Compound Rock, consisting of Diallage and Felspar. It is sometimes called Diallage Rock.

EUPHRA'SIA (from εὐφρασία, delight), a genus of Plants belonging to the natural order *Scrophulariaceæ* or *Scrophularineæ*. It has a campanulate 4-cleft calyx; the upper lip of the corolla galeate, emarginate, the lower larger, spreading, with the middle lobe emarginate; 4 stamens, fertile, the lower cells of the upper anthers with a long spur; the capsules oblong-ovate, compressed, emarginate, with entire valves; the seeds few.

E. officinalis, Euphrasy, Eyebright, has ovate or cordate-ovate nearly sessile serrate leaves, the corolla glabrous, the lobes of the lower lip emarginate, of the upper lip patent sinuate-dentate, the anthers unequally mucronate, hairy. It is from one to four inches high, and is a native of the heaths and pastures of Europe, the Himalaya Mountains, Cashmere, and all the north of Asia. It is common in Great Britain. This species is peculiarly subject to variation. The leaves are ovate, or cordate-ovate, or cordate-triangular, with the teeth acute or obtuse, ascending or spreading. The capsule also varies much in shape. There is scarcely a character permanent except the pubescence of the corolla. This elegant little plant has a slightly bitter and aromatic flavour, and has been employed much in medicine, particularly in diseases of the eye. Its use in these complaints seems to have originated in its bright appearance, and when the doctrine of signs and seals prevailed this was supposed to indicate its value in brightening the eyes. Although it has lately fallen into disuse its astringent effect is undoubtedly of value in certain diseases of the eye, and will explain the fact that Professor Kranichfeld has related of its being useful in catarrhal affections of the eye. The expressed juice and distilled water of this plant have been the forms in which it has been employed.

E. Odontites has the leaves narrowed from the base, opposite, linear-lanceolate, remotely serrate; the floral leaves longer than the flowers; the corolla pubescent; the lobes of the lower lip oblong, obtuse; the anthers with two equal points, hairy. It is a native of Europe, and is abundant in Great Britain in meadows, corn-fields, and waste places. This plant is the *Bartsia Odontites* of Hudson, and the *Odontites rubra* of Persoon.

There are several other species of *Euphrasia*. Although pretty plants none of them will grow well in cultivation.

(Babington, *Manual of British Botany*; Lindley, *Flora Medica*.)

EUPHROSINE, a genus of Dorsibranchiate *Annelida*. It has but one tentacle on its head.

EU'PODA (from εὖ, and πούς, ποδός, a foot), Latreille's fifth family of Tetramerous *Coleoptera*. The great size of the posterior thighs in many insects of this family gives rise to the appellation. The genus *Sagra*, many species of which, remarkable for brilliant red, purple, and green colours, are brought from the East, and the genus *Crisceris*, are types of sub-divisions of the family.

EUPYCHROITE, a fibrous mammillary variety of *Apatite*, from Point Crown, Essex county, New York, United States. [APATITE.]

EURIBIA. [THECOSOMATA.]

EU'RYALE (after one of the Gorgons, in allusion to the threatening armed appearance of the plant), a genus of Plants belonging to the natural order *Nymphæaceæ*. It has a calyx of 4 sepals inserted in the torus, and adhering to it; 16-28 petals; numerous stamens; 16-20 carpels; the fruit half-inferior, arising from the sepals; petals and stamens adhering half-way up. There is but one species of this genus, *E. ferox*, which is an elegant aquatic, covered all over with prickles, with large peltate orbicular leaves, and bluish-purple or violet flowers, about the size of those of the yellow water-lily. It is a native of the East Indies in the lakes Gumtoe and Gogra, also in the province of Kianaug in China. This plant presents a very singular appearance. Its petioles and calyces are hispid with stiff prickles. The leaves are about a foot in diameter. The root or rootstock contains starch, which may be separated as food, or the root may be eaten, as is done by the inhabitants of the districts where it grows.

In cultivation, this plant must be kept in water in a hotbed or stove. It will produce seeds if the pollen of the anthers, when it is in full bloom, be shaken on the stigmas. It can only be propagated by means of its seeds.

(Don, *Dichlamydeous Plants*.)

EURY'ALE. [ACALEPHÆ.]

EURYBIA. [ACALEPHÆ.]

EURYDICE. [ISOPODA.]

EURYLAIMUS. [MUSCICAPIDÆ.]

EURY'NOME, a genus of Brachyurous Crustaceans established by Dr. Leach, and forming the second genus of the Parthenopians of M. Milne-Edwards, who remarks that it establishes the passage between *Parthenope* and *Lambrus* and the other *Oxyrhynchi*. The general form of the body and aspect approximates these crustaceans to *Parthenope*, whilst the disposition of their external antennæ is similar to the conformation in *Maia*. The carapace is nearly in the form of a triangle with a rounded base, and is strongly tuberculated

Eurynome aspera.

and covered with asperities. The rostrum is horizontal, and divided into two triangular horns. The eyes are small; the orbits deep, their upper border very much projecting, and separated from the external angle by a slit. The internal antennæ are bent back longitudinally, and the first joint of the external antennæ terminates at the internal angle of the orbit. The epistome is nearly squared, and the third joint of the external jaw-feet strongly dilated externally. The sternal plastron is nearly oval, and its median suture occupies the two last thoracic rings. The feet of the first pair are scarcely longer than the succeeding ones; in the male they are rather long, whilst in the female they are very short, but less than those of the second pair; the succeeding feet diminish progressively in length. Abdomen consisting of seven articulations in both sexes.

E. aspera. Length about half an inch; colour lively red with bluish tints. Locality, the coasts of Noirmoutier and the Channel (La Manche), at rather considerable depths. (Leach; Milne-Edwards.) [PARTHENOPE.]

EURYNO'TUS, a genus of Fossil Ganoid Fishes, from the Limestone of Burdie House and the shales of Newhaven. (Agassiz.)

EURYO'CRINUS, a genus of Fossil *Crinoidea*, from the Mountain Limestone. (Phillips.)

EURYPODIUS. [MACROPODIDÆ.]

EURY'PTERUS (Harlan), a singular genus of Fossil *Crustacea*, from North America and Scotland. *E. Scouleri* occurs in Carboniferous Limestone at Kirkton, near Glasgow.

EURYSTOMIDÆ. [CORACIAS.]

EUSTACHIAN TUBE. [EAR.]

EUXENITE, a Mineral, containing Yttrium, occurs massive without any trace of cleavage. Its colour is brownish-black. In thin splinters it has a reddish-brown translucence, lighter than the streak. The streak is reddish-brown. Fracture subconchoidal. Hardness, scratches Thorite. Lustre metallic, greasy. Specific gravity 4·60. It is found at Jölster, in Norway. Its analysis, by Scheerer, gives—

Columbic Acid, with some Titanic Acid	49·66
Titanic Acid	7·94
Yttria	25·09
Protoxide of Uranium	6·34
Protoxide of Cerium	2·18
Oxide of Lanthanium	0·96
Lime	2·47
Magnesia	0·29
Water	3.97
	98·90

EVAGORA. [ACALEPHÆ.]

EVANIA. [PUPIVORA.]

EVENING PRIMROSE. [ŒNOTHERA.]

EVERGREENS are plants which shed their old leaves in the spring or summer after the new foliage has been formed, and which consequently are verdant through all the winter season; of this nature are the Holly, the Laurel, the Ilex, and many others. They form a considerable part of the shrubs commonly cultivated in gardens, and are beautiful at all seasons of the year.

The principal circumstances in which Evergreens physiologically differ from other plants are the hardness of their cuticle, the thickness of the parenchyma of their leaves, and the small number of breathing pores, or stomates, formed on the surface of those organs. These peculiarities, taken together, enable them to withstand heat and drought with more success than other plants, but are often not sufficient to protect them against such influences in excess. Hence we find them comparatively uncommon in those parts of the continent of Europe where the summers are hot and dry, and most flourishing in a moist insular climate like our own. This is rendered more intelligible by a comparison of the proportions borne by their stomates, and those of deciduous plants. As far as this subject has been investigated, it appears that their leaves are usually altogether destitute of such organs on the upper side, and that those of the lower are mostly fewer in number and much less active than in deciduous plants.

The greater part of Evergreens are raised from seed; some are propagated by cuttings or layers, and the variegated varieties by budding and grafting. The soil in which they succeed best differs with the kinds; American Evergreens, such as Rhododendrons, Kalmias, &c., grow best in equal quantities of peat-earth, sand, and vegetable mould; European sorts grow in their greatest vigour in a fresh hazelly loam, but will thrive in almost any kind of soil.

The operation of transplanting Evergreens may be performed with success at almost all seasons of the year. Midsummer planting has even been recommended; it however is a work of necessity rather than propriety, because its success depends entirely upon the nature of the weather after the operation; if it be cloudy and wet for some time they may succeed; but if, on the contrary, it be hot and dry, they are sure to suffer: for this reason, if the practice may be adopted, it is not to be recommended. The Common Holly however has been often known to succeed when planted at this season, either for hedges or as single plants. The hollies in one very remarkable case were carefully dug up in the cool of the evening, and removed to large trenches, which had been prepared for their reception; a quantity of water was then poured upon the roots, and the soil thrown upon the top of it, which of course was carried down and deposited in all the crevices in the trench, rendering the plants perfectly firm. In the instance alluded to the weather was very favourable for a considerable period after the operation was performed.

Autumn and spring are much better seasons for work of this kind; the plants are not so liable to suffer from the intense heat of the sun, and are more likely to be benefited by dews and frequent rains.

But, according to the most experienced cultivators, the winter months (that is, from October to February) are decidedly the best time for transplanting Evergreens. Mr. McNab, who is one of the greatest authorities upon this subject, says—"I have planted Evergreens at all seasons of the year with nearly equal success, except from the middle of June to the middle of August, and even during this period I have planted some; but unless the weather is very dull and moist, it is difficult to prevent the plants suffering considerably, and in many cases it is years before they recover. Although, however, I have planted Evergreens ten months out of the twelve with little difference of success, yet one season has a preference over the others with me, and when there is the power of choice I would recommend late in autumn, winter, or early in spring; that is, any time from the middle of October till the middle of February; and in general the beginning of this period is the best; that is, from the middle of October till the middle of December; always providing that the weather and the ground are favourable; that is, supposing there is no frost, no drying wind, nor much sunshine, and that the ground is not too much saturated with wet, either from continued rain or from the nature of the soil. One of the principal things to be attended to in planting Evergreens is to fix on a dull day for winter planting, and a moist day for spring and autumn planting."

It is of great importance to keep a number of the more tender sorts of Evergreens in pots, in order to send them to a distance if required; and if they are to be transplanted at home their roots are not so liable to be injured as when they are dug from the ground. The more tender species of the following genera should be treated in this way:—*Arbutus, Cupressus, Daphne, Erica, Juniperus, Laurus, Magnolia, Phyllirea, Pinus, Quercus, Rhamnus, Thuja*, &c.

In lifting Evergreens particular care should be taken of the young rootlets, as upon their preservation the success of the operation in a great measure depends; especially if the specimens have arrived at any unusual size. Small Evergreens are planted like other things; but the following precautions should be observed in all cases where individuals of any great size are the subject of the operation.

When the plant has been lowered into the hole dug for its reception, the soil must be thrown in loosely around it (not trod in), and a basin made to hold a quantity of water, which must be filled several times until the whole is completely saturated; this will convey the particles of soil down to the roots of the plant, and render it much more firm than any other method. By this treatment we have seen plantations of Evergreens formed without a single failure, which, when finished, appeared to have been growing for many years.

It matters little what size the plants have attained, if they can only be lifted without injuring the small fibres of the roots; they have been moved from 10 to 20 feet high, and otherwise large in proportion, with complete success. Should however the roots be unavoidably injured in transplanting, the branches must be closely pruned and shortened in proportion; so that when they begin to draw upon the roots for support they may not require more nourishment than the latter can supply.

Considering the great importance of Evergreens in a climate like that of Great Britain, where they flourish in such unrivalled beauty, and form so much natural protection to bleak exposed situations, they cannot be too extensively planted. The following lists will furnish information as to the principal kinds found in the nurseries and gardens of Great Britain:—

I. Evergreens whose beauty depends exclusively upon their foliage.

TREES.

Abies.—All the species, where the soil is light enough to suit them, particularly *A. Douglasii*, *A. excelsa*, the Norway Spruce, *A. Deodara*, the Cedar of India, *A. Cedrus*, the Cedar of Lebanon, and *A. Larix*, the common Larch, together with *A. balsamea*, the Balm of Gilead, *A. picea*, the Silver-Fir, and *A. Webbiana*, the Silver-Fir of the Himalaya Mountains. [ABIES.] The Cedar of Lebanon will grow well in a swamp.

Araucaria imbricata, the glory of the mountains south of Chili; it will hardly succeed north of the midland counties. [ARAUCARIA.]

Cunninghamia lanceolata, the Chinese Fir; very handsome, but only suited to the south of England. [CUNNINGHAMIA.]

Cupressus sempervirens, the Common Cypress, and *C. horizontalis*, the Spreading Cypress, are quite hardy: and the latter, if to be procured, forms a tree much more ornamental than the other with its formal shape. But the nurserymen almost always sell a slight variety of *C. sempervirens* for it. [CUPRESSUS.]

Cupressus Lusitanica, the Cedar of Goa, is a beautiful tree, but only suits the climate of southern counties.

Ilex aquifolium, Common Holly. The nurseries contain endless varieties of it, both green and variegated. The latter are not to be compared with the others for beautiful effect. [ILEX.]

Juniperus.—The *J. excelsa* forms a fine tree; *J. Virginiana*, the Common Virginian Cedar, is less handsome; but both are quite hardy. [JUNIPERUS.]

Pinus.—All the species, where the soil is light and sterile enough, with that proportion of decayed unfermented vegetable matter which this genus delights in. The finest, as ornamental plants, are *P. pinaster*, *P. Taurica*, *P. Pinea*, the Stone Pine, *P. nigricans*, *P. halepensis*, and *P. Pallasiana*, which will grow in any soil that is not stiff and swampy in winter. *P. sylvestris*, and *P. nigricans* are the hardiest. [PINUS.]

Quercus.—The *Q. Ilex*, or Evergreen Oak, of which there are many varieties; *Q. Austriaca*, of which the Lucombe and the Fulham oaks are possibly domesticated forms; *Q. Turneri*, *Q. Suber*, the Cork-Tree, and *Q. gramuntia*, the *Q. Ballota*, or Spanish Oak, with sweet acorns, are all fine species equally handsome when young as bushes, and when old as trees. [QUERCUS.]

Taxus baccata, the Common Yew, and *T. fastigiata*, the Irish Yew. [TAXUS.]

Thuja occidentalis, the American Arbor Vitæ, and *T. orientalis*, the Chinese Arbor Vitæ. [THUJA.]

SHRUBS OR BUSHES.

Aristotelia Maqui, a Chilian broad-leaved shrub, quite hardy.

Abies Clanbrasiliana, a curious dwarf fir, only suited to plant singly upon grass.

Cunninghamia lanceolata, the Chinese Fir, rarely grows beyond the size of a bush.

Arbutus Andrachne, the Oriental Strawberry-Tree, and *A. hybrida*. [ARBUTUS.]

Aucuba Japonica, a Japanese spotted-leaf bush. [AUCUBA.]

Buxus sempervirens, the Box-Tree, will succeed in light soil, especially if sandy and sterile; it prefers chalky downs, and will not thrive in stiff wet soil. [BUXUS.]

Juniperus communis, the Common Juniper; *J. Suecica*, the Swedish Juniper, much less handsome; *J. Sabina*, the Savin Bush, excellent for undergrowth, and ornamental as a single bush upon lawns.

Laurus nobilis, the Sweet Bay; quite hardy, though a native of the warm south; its aromatic leaves employed in confectionary, pickles, &c. [LAURUS.]

Ligustrum vulgare, the Common Privet; excellent for hedges and for undergrowth, especially the evergreen variety. [LIGUSTRUM.]

Phyllirea.—Every variety of this valuable genus should be cultivated: *P. obliqua* and *P. latifolia* as large species, *P. media* as a middle-sized one, and *P. angustifolia* as a graceful bush.

Pinus pumilio or *Mughus*, the Alpine Pine-Tree.

Rhamnus alaternus, of which there are several varieties, and *R. Clusii*; hardy bushes, which bear pruning or cutting down to the ground remarkably well. [RHAMNUS.]

TWINERS.

Hedera, many varieties of the common Ivy; *H. Canariensa*, the Irish Ivy; and *H. chrysocarpa*, the Golden-Berried Ivy. [HEDERA.]

II. Evergreens whose flowers have a conspicuous appearance.

TREES.

Andromeda arborea requires peat; grows 40 feet high in North America.

Arbutus Unedo, the Common Strawberry-Tree; of this there is a beautiful variety with deep red flowers, and another with double flowers, much less handsome than either.

Acacia affinis grows without protection near Edinburgh; *A. dealbata*, *A. lophanta*, and several other Australian species will flourish without protection in the southern counties. [ACACIA.]

Eucalyptus perfoliata, *E. pulverulenta*, exist in the open air near Edinburgh; they and other species will thrive in the south and west of England. [EUCALYPTUS.]

Ligustrum lucidum, the Wax-Tree, a Japanese plant.

Magnolia grandiflora, with many varieties; they are scarcely hardy enough to live in this country away from the shelter of a wall, except quite in the south; unprotected specimens exist however near Edinburgh. [MAGNOLIA.]

SHRUBS OR BUSHES.

Andromeda.—The handsomest species are *A. Catesbæi*, *A. angustifolia*, *A. Mariana*, which is rather tender, *A. pulverulenta*, *A. speciosa*, and *A. floribunda*. They require peat soil.

Arctostaphylos Uva-Ursi, a trailing plant. [ARCTOSTAPHYLOS.]

Ammyrsine Lyoni, a beautiful little American bush, requiring peat.

Berberis aquifolium, *B. fascicularis*, *B. repens*, *B. Asiatica*, *B. aristata*. [BERBERIS.]

Bupleurum fruticosum stands the sea breeze well upon chalky cliffs. [BUPLEURUM.]

Cistus, all the species. They are quite hardy if planted where wet cannot lodge in winter, and exposed to the full sun in summer. [CISTUS.]

Colletia spinosa.

Cotoneaster microphylla and *C. rotundifolia*, small bushes. [COTONEASTER.]

Cytisus scoparius, Common Broom; there is a double variety; *C. albus*, the Portugal White Broom. [CYTISUS.]

Daphne.—All handsome, the following the most so: *D. Laureola*, the Spurge-Laurel, grows well beneath trees; *D. pontica*, with pale green fragrant flowers; and *D. Cneorum*, or Garland-Flower, one of the most lovely and sweetly-perfumed plants in the world, but not to be cultivated except in a dry peaty soil and a well ventilated situation; late spring frosts injure it so much that it is not worth cultivating in valleys. [DAPHNE.]

Durana dependens, and some others.

Erica Australis, E. carnea, E. stricta, E. Mediterranea, E. codonodes. [ERICA.]

Escallonia rubra, E. illinita, E. Montevidensis, handsome South American shrubs. Bees take great delight in the blossoms of the last; the second species smells very strongly of melilot.

Garrya elliptica, with long pendulous catkins of a yellowish-green colour. [GARRYA.]

Genista tinctoria, the Dyers' Broom, with a few others. [GENISTA.]

Helianthemum, of all kinds, to cover rockwork, or ground where the wet does not lodge in winter.

Kalmia latifolia, K. angustifolia, especially the first; require peat. [KALMIA.]

Lavandula spica and *L. latifolia*, Common Lavender. [LAVANDULA.]

Ledum latifolium, Labrador-Tea, and *L. palustre;* low bushes requiring peat. [LEDUM.]

Menziesia polifolia, Irish Heath; there is a white variety. [MENZIESIA.]

Myrtus communis, and its varieties; lives out of doors south of London. [MYRTUS.]

Prunus Laurocerasus, the Common Laurel; *P. Lusitanica*, the Portugal Laurel. [PRUNUS.]

Pittosporum Tobira, quite hardy south of London; sweet-scented. [PITTOSPORUM.]

Rosmarinus officinalis, Common Rosemary. [ROSMARINUS.]

Rhododendron.—Numerous varieties are to be procured; those of *R. ponticum, R. maximum*, and *R. catawbiense* are the must robust; *R. hybridum* obtained between the Indian and American species is less hardy; *R. ferrugineum* and *R. hirsutum*, dwarf alpine species; *R. campanulatum*, a North Indian species. [RHODODENDRON.]

Spartium Junceum, Spanish Broom; and *S. acutifolium*, a Turkish Broom. [SPARTIUM.]

Viburnum.—Of the Laurustinus, one of the prettiest of all Evergreens, there are three species: *V. Tinus*, the Common Laurustinus, the hardiest: *V. lucidum*, with shining leaves, rather larger and more delicate; *V. strictum*, with upright shoots, more hairy, and the least hardy of the three. [VIBURNUM.]

Ulex Europæus, the Common Furze; a double variety, which is particularly handsome; and *U. strictus*, the Irish Furze, a smaller species, which does not flower abundantly. [ULEX.]

Yucca.—Several species quite hardy. They only require to be grown in places where water does not stagnate in winter; *Y. gloriosa, Y. filamentosa, Y. Draconis, Y. flaccida*, and *Y. superba*, are the handsomest species. [YUCCA.]

TWINERS OR CLIMBERS.

Bignonia capreolata, with dull brownish-red trumpet-shaped flowers; rather tender. [BIGNONIA.]

Caprifolium flexuosum, C. gratum, C. Japonicum, C. sempervirens; all handsome Honeysuckles. [CAPRIFOLIACEÆ.]

Jasminum revolutum and *officinale*, the Common White Jasmine. [JASMINUM.]

Vinca major and *minor*, the Larger and Smaller Periwinkle; they are trailing plants. [VINCA.]

EVERLASTING FLOWERS. This name is popularly given to certain plants whose flowers have the property of retaining their brightness and colour for many months after being gathered. They owe this quality to a hardness of their tissue, which has exceedingly little moisture to part with, and which, consequently, does not collapse or decay in the progress of acquiring perfect dryness. It is generally in the scales of the involucre of composite plants or in the bracts of others that this property resides. Those who wish to possess such plants will easily find the following in the gardens of this country.

Hardy Annuals.—*Helichrysum bracteatum* (yellow), *Xeranthemum annuum* (purple or white).

Hardy Perennials.—*Antennaria dioica* (pink), *A. triplinervis* and *A. margaritacea* (white). *Ammobium alatum* (white). *Gnaphalium stœchas* and *G. arenarium* (yellow).

Tender Annuals.—*Rhodanthe Manglesii* (red), *Morna nitida* (yellow), *Gomphrena globosa* (purple).

Greenhouse Shrubs or Herbaceous Plants.—*Astelma eximium* (crimson), *Helichrysum argenteum* (white), *H. ericoides* (pink), *H. sesamoides, H. proliferum*, and others (purple).

EVERNIA. [LICHENS.]

EVO'DIA (from εὐωδία, a sweet smell), a genus of Plants belonging to the natural order *Rutaceæ*. It has the calyx 4-5-parted; 4-5-equal petals; 4-5-stamens, smooth; the filaments subulate; the anthers heart-shaped, moveable; the disc cup-shaped, sinuated; the ovary single, deeply 5-lobed, with two collateral ovules in each cell; the style single, very short; the stigma terminal, obtuse; the cocci 2-valved, 1-seeded, with a separable 2-valved endocarp. The species are shrubs and trees, with a grateful smell.

E. febrifuga is a tree, and has trifoliate leaves, the leaflets lanceolate elliptical, somewhat acuminate; the panicle terminal, downy; the ovary simple, warted. It is a native of the forests of the province of Minas Geraes in Brazil. The bark and young wood are bitter and astringent, and are employed by the medical practitioners of Brazil as a tonic and febrifuge.

E. hortensis has simple or trifoliate leaves, which are pubescent as well as the branches. It is a native of the Friendly Islands and the New Hebrides.

E. drupacea has smooth leaflets, and a 4-seeded drupaceous fruit. It is a native of New Caledonia. The last two are shrubs. All the species are worth cultivation on account of their agreeable scent. They may be grown in a mixture of loam, peat, and sand, and propagated by means of cuttings, which should be allowed to strike root under a hand-glass in heat.

(Lindley, *Flora Medica;* Don, *Dichlamydeous Plants.*)

EXCÆCA'RIA, a genus of Plants belonging to the natural order *Euphorbiaceæ*. It has monœcious or diœcious amentaceous flowers; the sterile flowers nothing but staminiferous bracts; the stamens 7-9, united into about three parcels, all connected at the base; the fertile flowers with the calyx 3-fid or absent; the style 3-parted; the capsule 3-coccous.

E. Agallocha is a small crooked stunted tree, with alternate leaves about the extremities of the branches, stalked, ovate, or cordate, but usually acute at the base, smooth on both sides, remotely and slightly serrate, pointed with two glands at the base, and about two inches long; the petioles about an inch long, smooth, channelled; the stipules small, fine-pointed. The trunk of this plant abounds in a virulently acrid milk, which acts as a powerful poison. Roxburgh says that wood-cutters who accidentally injure this tree have inflammations and ulcerations on those parts of the body where the milk touches. Rumphius calls this tree 'Arbor excæcans,' and says that the Dutch sailors who were sent ashore at Amboyna to cut down timber became furiously mad from the pain produced by the juice of this tree getting into their eyes, and that some of them lost their sight altogether. This tree is common on various parts of the continent of India, and in the Indian Islands, especially near the coast. Its specific name appears to have been given it on the supposition that it was one of the plants that yielded the *Agallochum*, or Aloes-Wood, but this is not the case, and this wood is yielded by a different family of plants. [AQUILARIACEÆ.]

(Lindley, *Flora Medica*).

EXCENTROSTOMATA. [ECHINIDÆ.]

EXCRETION in Plants. [ROOT.]

EXIDIA. [TREMELLINI.]

EXILARIA. [DIATOMACEÆ.]

EXOCA'RPEÆ, a small division of Thymelaceous Plants. [THYMELACEÆ.]

EXOCETUS, a genus of Fishes belonging to the Abdominal *Malacopterygii*, forming part of the family *Esocidæ*. The distinguishing characters are—pectoral fins nearly equal to the body in length; head flattened above and on the sides; the lower part of the body furnished with a longitudinal series of carinated scales on each side; dorsal fin placed above the anal; eyes large; jaws furnished with small pointed teeth.

The species of this genus are called Flying Fishes. The species of the genus *Dactylopterus* [DACTYLOPTERUS] are also known by this name.

The species of *Exocetus* when in their own element are constantly harassed by various fishes of prey; and it is supposed that their flights are performed for the purpose of escaping from these enemies: when in the air however they are subject to the attack of various species of gulls.

Whether these fishes possess the power of flying, in the true sense of the term—that is, by beating the air with their members, or whether their large fins merely serve as parachutes to sustain them in the air for a short time, after a leap from the water, is not yet fully ascertained; observers having given different accounts. The latter is perhaps the prevailing opinion of naturalists, and is that of the more recent observers. "I have never," observes Mr. George Bennett, the author of 'Wanderings in New South Wales,' "been able to see any percussion of the pectoral fins during flight; and the greatest length of time that I have seen this volatile fish on the fin has been thirty seconds by the watch, and their longest flight mentioned by Captain Hall has been 200 yards, but he thinks that subsequent observation has extended the space. The most usual height of flight, as seen above the surface of the water, is from two to three feet, but I have known them come on board at a height of 14 feet and upwards; and they have been well ascertained to come into the channels of a line-of-battle ship, which is considered as high as 20 feet and upwards. But it must not be supposed they have the power of elevating themselves in the air after having left their native element; for, on watching them, I have often seen them fall much below the elevation at which they first rose from the water, but never in any one instance could I observe them rise from the height at which they first sprang; for I regard the elevation they take to depend on the power of the first spring or leap they make on leaving their native element."

Judging from the foregoing quotation, and several other accounts which we have perused, it would appear that something beyond the mere leap of the fish would be required to account for the great heights (of 14 or 20 feet) at which these fishes have been seen. If they cannot fly (which one would judge to be the case upon examining the structure and position of the fins), it seems probable that they take advantage of the wind at times, and so adjust their fins that they are carried upward by it.

Several instances are on record of the appearance of Flying Fishes off the British coast, but the species is doubtful. It is probable that both the *Exocetus exiliens* and the *E. volitans* may have made their appearance in our seas; these two species being very abundant, the former in the Mediterranean Sea (where many fishes similar to those of our own coast occur), and the latter in the Atlantic Ocean.

The *E. exiliens* has the ventral fins placed behind the middle of the body, and the *E. volitans* has the ventrals (which are much smaller than in *E. exiliens*) placed anterior to the middle part of the body: these two species therefore are easily distinguished; of the latter there is a figure in Yarrell's 'British Fishes.'

The American seas afford us examples of other species of this genus.

E'XOGENS, the largest primary class in the vegetable kingdom, are so named in consequence of their woody matter being augmented by additions to the outside of that which is first formed near the centre. As long as they continue to grow they add new wood to the outside of that formed in the previous year, in which respect they differ essentially from Endogens, whose wood is constructed by successive augmentations from the inside. [ENDOGENS.] All the trees of cold climates, and the principal part of those in hot latitudes, are exogenous. In many cases they are easily recognised by the wood of each different year forming a distinct zone, so that a section of their wood exhibits a number of concentric circles; but there are so many exceptions to this rule as to render it necessary to consider this character as by no means essential to them.

The nature of the exogenous mode of growth will be best compared with that of an Endogen, if we pursue the same mode of illustration as in the article which treats of the latter form. We will therefore proceed from an explanation of the typical mode of growth in a common Exogen to such remarks as we may have to offer upon deviations from it.

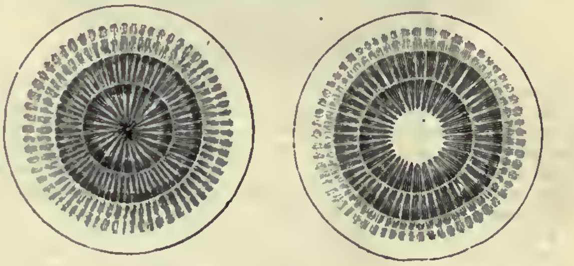
In an Exogen of ordinary structure the embryo consists of a cellular basis, in which there is usually no trace of woody or vascular tissue; but as soon as germination commences fine ligneous cords are seen proceeding from the cotyledons towards the radicles from the opposite sides of the young stem, meeting in the centre of the embryo, and forming a thread-like axis for the root. As the parts grow the ligneous cords are increased in thickness and number, and having been introduced among the cellular basis of the embryo, are separated from each other by a portion of the cellular substance, which continues to augment both in length and breadth as the woody cords lengthen. By degrees the plumule or rudimentary stem becomes organised, and having lengthened a little, forms upon its surface one, two, or more true leaves, which gradually expand into thin plates of cellular substance traversed by ligneous cords or veins converging at the point of origin of the leaves. If at that time the interior of the young plant is again examined, it will be found that more ligneous cords have been added from the base of the new leaves down to the cotyledons, where they have formed a junction with the first wood, and have served to thicken the woody matter developed upon the first growth. Those ligneous cords which proceed from the base of the leaves do not unite in the centre of the new stem, there forming a solid axis, but pass down parallel with the outside, and leave a small space of cellular tissue in the middle; they themselves being collected into a hollow cylinder, and not uniting in the middle until they reach that point where the woody cords of the cotyledons meet to form the solid centre of the root. Subsequently the stem goes on lengthening and forming new leaves: from each leaf there may be again traced a formation of woody matter disposed cylindrically as before, and uniting with that previously formed, a cylinder of cellular substance being left in the middle; and the solid woody centre of the root proceeds in its growth in a corresponding ratio, lengthening as the stem lengthens, and increasing in diameter as the leaves unfold and new woody matter is produced: the result of which is, that when the young Exogen has arrived at the end of its first year's growth it has a root with a solid woody axis, and a stem with a hollow woody axis surrounding cellular tissue, the whole being covered in by a cellular integument. But as the woody cords are merely plunged into a cellular basis, the latter passes between them in a radiating manner, connecting the centre with the circumference by straight passages, often imperceptible to the naked eye, but always present. The following diagram illustrates this.

Here we have the origin of pith in the central cellular tissue of the stem, of wood in the woody axis, of bark in the cellular integument, and of medullary processes in the radiating passages of cellular tissue connecting the centre with the circumference.

The woody axis is not however quite homogeneous at this time. That part which is next the centre contains great numbers of vessels of different kinds, particularly dotted vessels (vasiform tissue); the part next the circumference is altogether destitute of vessels, and consists of woody tissue exclusively: of these two parts that with the vessels belongs to the wood, properly so called, and serves as a mould on which future wood is added; the other belongs to the bark, separates under the form of liber, and in like manner serves as a mould upon which future liber is disposed.

Root. Stem.

At the commencement of a second year's growth the liber separates spontaneously from the true wood, a viscid substance called Cambium is secreted between them, and the stem again lengthens, forming new leaves over its surface. The ligneous cords in the leaves are prolonged into the stem, passing down among the cambium, and adhering in part to the wood and in part to the liber of the previous year, the former again having vessels intermingled with them, the latter having none. The cellular tissue that connected the wood and liber is softened by the cambium, and grows between them horizontally while they grow perpendicularly, extending to make room for them, and consequently interposed between the woody cords of which they each consist, forming in fact a new set of medullary processes terminating on the one hand in those of the first year's wood, and on the other in those of the first year's liber. This addition of new matter takes place equally in the stem and in the root, the latter extending and dividing at its points, and receiving the ends of the woody cords as they diverge from the main body. The following diagram illustrates this, and shows, when compared with the last, what difference there is in the appearance of the stem of an Exogen one and two years old.



Root. Stem.

And thus, year after year, the Exogen goes on, forming zone upon zone of wood, which is permanent, and zone within zone of liber, which perishes as the stem increases in diameter. [BARK.]

If this account is compared with that given of Endogens, it must be obvious that the stem of these two great classes is formed from the very beginning in an essentially different manner. Endogens have no cylindrical column of pith; their woody arcs are never collected into a cylinder, through the sides of which the cellular tissue passes in the form of medullary processes; and the woody matter of their bark, so to call their cortical integument, is not parallel with that of the wood and spontaneously separable from it: not to speak of important anatomical differences, or of the concentric arrangement eventually assumed by the wood of Exogens. In both Exogens and Endogens a cellular substance is the basis of the whole structure, and extends horizontally wherever it is necessary to do so; and in certain Exogens woody arcs, stated to be like those of Endogens, are found in the pith. These cases properly belong to anomalous forms, but nevertheless may be noticed here, in consequence of their direct connection with this branch of the subject. One case is that of *Zamia*; but as that genus now belongs to the new class of Gymnosperms and not to Exogens proper, it need not be considered here. The other cases are *Piper*, Nyctaginaceous plants, and some others. Professor Schultz states ('Natürliches System des Pflanzenreichs,' p. 320, &c.) that in *Piper*, *Mirabilis*, and *Boerhaavia*, the central part of the stem consists of cellular tissue, amongst which cords of spiral vessels and woody tissues are placed either without order, or (in *Boerhaavia*) in a cruciate manner, as in Tree-Ferns, and that on the outside of this the woody bundles are arranged circularly into a cylinder. A similar statement had long previously been made by Mirbel, who ascribes to *Mirabilis* and some Umbelliferous plants longitudinal vessels in the pith ('Elém. de Physiol. Veget.,' i. 112), and by Professor Meyer, who finds the pith of *Mirabilis longiflora*, *M. dichotoma*, *Boerhaavia scandens*, and *Oxybaphus Cervantesii* abounding in many large bundles of spiral vessels within the woody radiated zone. ('De Houttuynia atque Saururcis,' p. 40.) This, if correctly described, only shows that in certain Exogens a portion of the central tissue is placed at first in a confused manner, and that the wood does not assume a definite circular disposition till afterwards; that it does assume it eventually is admitted. We find in *Piper nigrum* and *P. Lonchitis* that from the beginning the woody bundles are placed circularly, but they are separated by a good deal of cellular tissue, and do not assume in the first zone the wedge-like or triangular form which is most common in Exogens, and which they themselves at last take on. In *Boerhaaria repanda*, a specimen of which is now before us, we find the wood regularly disposed in two zones, and instead of spiral vessels a very singular structure in the pith, which is filled with fistular passages of lax soft spheroidal cellular tissue, surrounded by smaller, harder, and more cubical cellular tissue which passes off into the medullary processes. It is in such plants as *Piper incanum* that the organisation of Exogens most nearly approaches that of Endogens; but in the first place the whole race of Pipers forms a sort of transition from Exogens to Araceous Endogens; and secondly, it is probable that when they are most endogenous in appearance they are not really so in regard to the final development of their woody tissue.

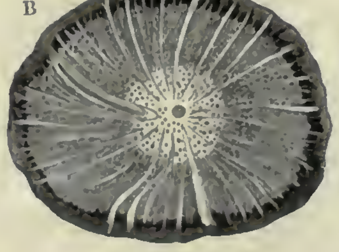
Let it however be admitted that in certain cases Exogens are in the centre of their stem organised less regularly than usual; this will offer no argument in favour of their analogy with Endogens. In all such cases it will be found that they eventually assume their typical conformation. We are acquainted with some striking proofs of this. Among twining plants of tropical countries we occasionally find instances like the following:—

A

Beneath a most irregularly-compressed and lobed bark there lies a mass of wood, apparently so confused and irregular in its arrangement in the centre, that nothing symmetrical can be made out by the most acute observer; but it will be seen that towards the circumference it distinctly assumes the radiated appearance of an Exogen. In other cases, where the structure is sufficiently regular, this circumstance is still more distinctly illustrated.

It is however more commonly at the centre that we look for typical structure, and at the circumference that we find irregularity; as if Exogens usually commenced their growth according to the plan to

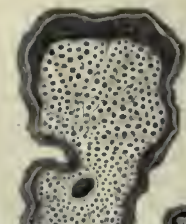
B



C

which nature has subjected them, and only deviated from it under the influence of unknown causes coming into operation and controlling their development after they have advanced to a certain stage in their growth. Thus, in the singular instances shown in cuts D, E, F, and G, the principal part of the stem is so confused and irregular as to look more like an Endogen than an Exogen, and a fragment might easily be mistaken for the former; nevertheless in a young and tolerably regular shoot (D) the radiated appearance is sufficiently well-marked; and in two others, irregular and distorted as they are (E and G), the central pith is visible, although far out of the centre; and in the fourth (F) the centre has not only pith, but a radiated structure that is quite regular.

D



E

F

G

By far the most singular case of this sort is in an unknown twining plant in the possession of Dr. Lindley, from the Malayan Archipelago, of which the cuts H and I are representations. In old stems of this plant a section exhibits a most irregular combination of wood, looking like palm wood, broken up into lobed cords lying amongst still more irregular cellular tissue, and inclosed in a common bark; so that we doubt whether it would be possible to tell to which class it really belongs, if it were not for its young shoots and the pith of the old ones. The latter may be seen lying quite out of the centre towards one side (near the bottom of our figure, a little to the right); and in the former (H) the pith is found with wood radiating around it, although still with sufficient irregularity.

H

I

The cases already given are evidences of exogenous wood being sometimes extremely different from the condition in which we see it in Europe, and attest the necessity of forming our ideas of its nature from a more extended examination than that which is commonly given to it. Several curious cases have been also published by Dr. Lindley in his 'Introduction to Botany' (ed. 2, p. 77, &c.), and others have been noticed by Schleiden and other writers.

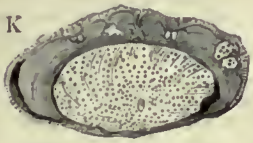
Irregularity in the structure of exogenous wood is usually owing either to a confused disposition of the tissue at some particular period of the growth, or to some derangement of the medullary processes, or to the absence of concentric circles, or to the formation of a deep zone of cellular tissue alternately with each zone of wood, or, finally, to the production of wood within the bark instead of beneath it. The first cause has been already sufficiently illustrated.

The sinuosity and partial obliteration of the medullary processes is a principal cause of the anomalous appearances at *figs.* D, E, F, G, where they are reduced to fine lines, only visible beneath a microscope, and not radiating from the centre, but disposed in no certain manner, sometimes even transversely, owing to the excessive disturbance of the wood itself. In *fig.* I, the singularity of structure is owing in part to the excessive irregularity with which the wood has been developed, and in part to the looseness and irregular shape of the medullary rays, which seem huddled as it were round the woody cords; the latter are moreover extremely variable in size, some of them being as much as half an inch in diameter, and others so small as to consist of no more than a single vessel with its usual coating of woody tissue.

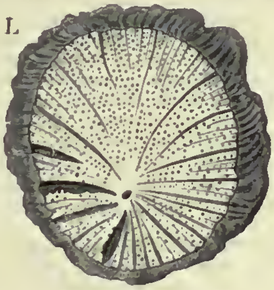
The absence of concentric circles is an extremely frequent occurrence in the wood of tropical countries, and it is almost certain that many families of Exogens never form them visibly under any circumstances. We say visibly, because in fact they must be annually formed in all cases, although we do not see them. The reason why Exogens have their wood marked by concentric circles is, that the ligneous tissue formed at the end of a season is more compact than that formed at the beginning, and hence, as the two are in juxtaposition, the difference in their density distinctly separates the one from the other. But if, from any cause,—whether proper to plants as species, or owing to the external influence of an equable climate—the tissue of wood formed at all seasons is exactly alike, no zone will be visible, although in fact the formation of the wood is exogenous in the most regular manner. Such cases are seen at *figs.* K, L, S, and elsewhere in the illustrations of the present article.

It is not a little remarkable however that while the wood in some cases has no trace of zones, the bark should show them most distinctly, as in the instance of *fig.* K.

K



L



O

P

N

M

Q

When a deep zone of cellular substance is formed between each zone of wood, a curious banded appearance is produced, as in the singular Indian climber marked N M O P Q, where extremely excentrical growth is combined with this peculiarity. At N we have the stem two years old, the second zone passing pretty regularly round the first aud cut off from it by a broad deep band. At M the specimen is of the same age, but the second zone is formed on one side only. At O the specimeu is two years old, with the first zoue perfect, but the second broken up into a number of unequal irregular pieces, and it would seem as if a third growth had commeuced ou one side (to the left of the cut). At P the growth is of three zones, both the second and third being much lobed, and the third only extending three quarters round the second. Finally, at Q, where the irregularity is the greatest, there is a growth of four zones, the first symmetrical, the second very much deeper on one side thau the other, the third but half surrounding the second, aud the fourth formed only along two ridges on the third.

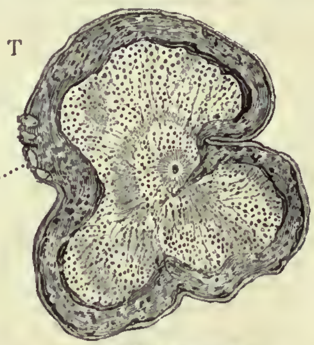
If it happens that, in addition to the presence of a thick cellular layer between each zone, the medullary processess are also very thick, an appearance still different from the last is produced, as at *fig.* R.

R

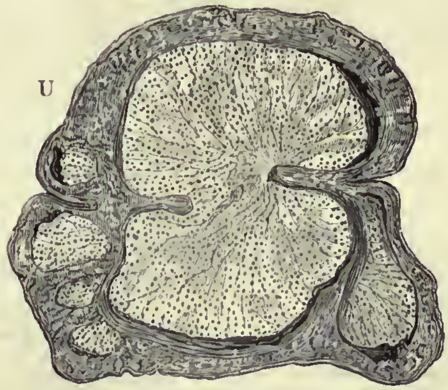
S

That wood is sometimes formed in the bark itself has been long since shown by Mirbel, in the case of *Calycanthus floridus*, where four additional woody columns appear equi-distant iu the bark, without any separate pith, but radiating from their first line of origin. We are now acquainted with mauy such cases. In *fig.* T are the commencement of four such columns at *a* on one side; but in that specimen no further indication of such a structure is visible; but at *fig.* U, which

T



U



is the same plant in a more advanced state of growth, four such columns on one side and one on the other have acquired considerable size, and each radiates towards the circumference of the stem. As in the *Calycanthus*, so in these and all the other instances of the same kind, which these cuts represent (see F, K, and S), the woody columns of the bark are destitute of pith.

Perhaps what we have called the separation of zones of wood at N, M, O, P, Q, R, by thick layers of cellular tissue, are rather to be considered as other instances of wood formed in bark, but in a regular and uniform manner. We are however uncertain how this may be, and prefer allowing the statement to stand in its present form until some one shall have examined such plants in their native forests at Singapore.

In addition to such anomalous kinds of structure as those now described, Exogens, like Endogens, contain species, the organisation of whose stem is so imperfect as to be reducible within no certain rules. Not to speak of *Callitriche*, *Ceratophyllum*, or *Myriophyllum*, wherein vessels are scarcely developed, and the woody matter merely forms a simple central axis of growth, we have in this class an exact parallel with *Lemna* among Endogens; some Podostemaceous plants have their leaves and stem completely fused together so as to resemble a *Marchantia* or an *Alga*. Such plants are to be regarded rather as instances of imperfect organisation than as deviations from a typical form; and it is by no means a violent supposition to conclude that if their organisation were more complete it would then become such as is characteristic of the class to which they belong.

Schleiden, in his 'Principles of Scientific Botany,' has treated the structure of the stems of Exogens in his usual lucid manner, and we subjoin an analysis of his views upon the subject. He divides the Dicotyledonous axial organs into two groups, the stalks and stems. Of the stalks he says they frequently exhibit no essential differences from those appertaining to Monocotyledonous plants, since the distinction of the unlimited or indefinite vascular bundles is often imperceptible in the growth of one year. But the vascular bundles generally close in the first year into a simple circle, and the external parts in several circles to form a ring, so that the parenchymatous masses separating the individual bundles are compressed together into medullary rays. In most cases the vascular bundles run from below upward in straight parallel lines. They form a loop where the leaf begins, the edges of which furnish vascular bundles for the leaf and the axillary bud, and the pith of the bud is thus brought in connection with that of the stem by means of their opening, as in the case of *Tropæolum*. The vascular bundles supplying the leaves and buds generally separate from this loop exactly at the point where they enter the leaf. Sometimes however they first pass through a longer portion of the parenchyma of the pith or the bark (as in the *Amaranthaceæ* and *Chenopodaceæ*). In perfect nodes loops of vascular bundles are seldom found passing across the stem; in general the parenchyma merely appears to be tougher and closer at these points. We are here, on the whole, very destitute of accurate investigations, more especially with regard to the first year's stalk with undeveloped internodes.

Stems differ in structure according as the internodes are developed or undeveloped. Those with developed internodes are divided into several sections:—

A. With a Simple Ring of Vascular Bundles.—Here the vascular bundles very seldom run parallel, but generally in serpentine lines, alternately approximating and retreating from each other; the meshes thus formed are filled by the medullary rays. Where liber-bundles lie in front of the vascular bundles they follow the same course. Large and small medullary rays and annual rings are formed in the manner indicated. Wherever there is a leaf, one large or several smaller loops are formed, from whose circumference the vascular bundles are given off for the leaf and axillary bud, while the openings furnish parenchyma for the formation of the bud. The vascular bundles of every newly developed internode stand in immediate connection with, and are immediate prolongations of, that portion of the vascular bundle of the preceding internode still capable of development, and thus the cambium of the vascular bundles forms a continuous net through the stem and branches of the whole plant. During the developments of the vascular bundles of the stem, and those connected with them, and belonging to an axillary bud that grows into a branch, the base of this branch becomes more and more covered with newly formed wood. We thus see the same condition established as in the Monocotyledons: an under lateral branch crosses all the layers of wood passing to the upper parts. The difference is merely, that in the Dicotyledons they are portions of the continuous mass of the progressively developing vascular bundles; while in the case of Monocotyledons they are discrete parts, new vascular bundles.

B. With Several Concentric Rings of Vascular Bundles.—This condition appears to be only met with in *Piper* (?) and *Pisonia*; and, perhaps, in a few of the *Crassulaceæ*, as in the *Crassula*. The separate vascular bundles continue to grow, and finally close into a firm woody mass; each however retains its own cambium, and likewise a small portion of parenchyma, not perfectly dislodged: such, at any rate, is certainly the case in *Pisonia*.

C. Stems of Climbing Plants.—The stems of many tropical climbers (Lianes, Llanos) exhibit a peculiar structure, which has long been misunderstood. Even in our own indigenous plants we meet with some indications of it. In the first year, most of them exhibit nothing striking, if we do not regard the generally square stalk as such; and we find that they have a simple ring of vascular bundles, which closes towards the end of the first period of vegetation into an ordinary wood cylinder. In the following years however the peculiarities are more and more strikingly manifested, consisting in the wood not being uniformly developed towards the exterior throughout its whole circumference, but ceasing to grow at definite parts, often regularly, and as frequently in a fantastically irregular manner, allowing the substance of the bark to replace it. In this manner stems are produced, which, in a transverse section, exhibit the most varied distribution of the wood. We meet with the first indications of this peculiarity in our indigenous species of *Clematis* forming stems; in the strikingly broad and regularly arranged large medullary rays; and in the six narrower portions of wood which are not nearly so fully developed towards the exterior as the six broader ones. To these we may add the *Bignoniaceæ*. After the wood has continued for some time to be regularly developed, it ceases growing in four different places, so that the bark is no longer pushed outward; and on the further development of the wood in the remaining places, the bark forms, in the transverse section, four septa of variable thickness between the four portions of wood.

In some species these cortical masses become a definite degree broader in each succeeding annual ring, so that a sharply marked step is formed on each side; in another species all that is formed are four very thin flat plates, wholly separated (in consequence of drying) from the wood. Still more striking is the cross-section of many climbers of the family of *Sapindaceæ*. A hasty glance would lead us to imagine that we had here a cylinder of wood surrounded with bark in which other stems or branches with their bark had become blended in their growth. A minute observation however refutes this view at once from the absence of pith in the exterior woody masses.

Finally, the most astounding phenomena are seen in the families of the *Aristolochiaceæ*, *Asclepiadaceæ*, *Malpighiaceæ*, *Bauhiniæ*, in which, in the transverse section, the woody mass appears divided in the strangest ways by cortical substance, separated into various portions, and often elegantly lobed.

The great diameter of the porous tubes may apparently be regarded as a general peculiarity in the ligneous structure of all climbing plants. These have also strikingly large pores which (as I have never yet seen in vessels) form even ramified canals, as is seen particularly well in *Bauhinia*.

Of Stems with Undeveloped Internodes, Schleiden says they have scarcely been investigated at all in the Dicotyledons. Most of them remain very short, since they die below as they increase upward. They belong principally to the subterraneous stems and rhizomes. The leafless *Euphorbiaceæ*, *Carica*, *Theophrasta*, *Nymphæa*, and *Nuphar*, as well as many *Cactaceæ*, afford excellent material. The most important researches in reference to this point are those of Schleiden, into the stems of *Cactaceæ*, especially *Mammillaria*, *Echinocactus*, *Melocactus*. The vascular bundles at first make an arc of considerable curvature; by the gradual development of the pith the curvature becomes almost effaced, and it only remains in the upper part, where the vascular bundles pass off to the leaves. The first succeeding layer developed in the vascular bundle is applied over and up beyond this, dividing at the point where the primary vascular bundle goes off to the base of the leaf, and uniting again above to pass up to the base of a leaf situated higher up. The next layer of structure forms in the same way, by splitting and reuniting, two meshes, one for the primary vascular bundle, and one for the portion of the first layer of increase, running to the upper leaf, then above this it runs up to the base of another leaf. This structure is continued up throughout the whole stem, which thus possesses a form of wood exhibiting perfectly regular meshes, or areolæ, which appear to be formed by an alternating superposition of vascular bundles, and each gives passage to a bundle coming from the innermost part of the wood. Of course there is here a perfect crossing of the vascular bundles going to the lower leaves by all the subsequently formed portions of vascular structure, and by a little care we may make preparations not very unlike the structure of a Monocotyledonous stem with undeveloped internodes. The whole structure bears great similarity to that of the arborescent Ferns, allowing for the different nature of the vascular bundles and the difference of dimension.

Many interesting varieties in the structure of the wood occur here also; and the wood of the *Mammillariæ* and *Melocacti*, composed entirely of peculiar spiral-fibrous cells, is particular worthy of notice.

The stems of the *Rhizanthaceæ* (Blume) appear to be altogether aberrant and irregular in their structure. As a general rule, we may say that in the Monocotyledons the vascular bundles are simplest in their lower part, often, for instance in the Palms, composed at that part solely of elongated parenchyma (liber); in the middle becoming more complicated from within outward, exhibiting almost all the forms corresponding to the varied expansion of the cell; above they become simpler again, particularly where they pass off into a leaf or branch, and consist frequently merely of such elements as correspond to a considerable expansion in the longitudinal direction after the appearance of layers of thickening. In the Dicotyledons the vascular bundles appear to have a tolerably uniform structure below and in the middle, but toward the upper end the onward developing portion of each older bundle passes into the form of a primary bundle, or, in other words, every primary vascular bundle of a new internode appears as the immediate prolongation, not of the primary bundle of the preceding internode (which rather runs to a leaf), but of the layer of increase of this, the elementary portions of which do not correspond to any expansion in the longitudinal direction.

On the literature of this subject Schleiden says—"Almost all that has been said by isolated authors is wholly useless, either because they have had no regard to the history of development, or, if they have noticed this, have spoken so indiscriminately of growth, increase, and enlargement, without distinguishing whether new cells have originated, cells already existing expanded, or merely become transformed into different tissues by the alteration of the form and configuration of their walls.

"Two notions there are especially which have long sadly confused our science, from which a correct method would have completely saved us, since both were, at least at the time, and in the species on which they were built up, wholly unfounded fables, having no connection with any guiding principles, and consequently never should have assumed scientific perspicuity, much less, as did happen, have served as a temporary basis for theories pervading the whole science of botany.

"The first is the idea of Desfontaines of the distinction between Monocotyledons and Dicotyledons, that the former develop new structure in the centre of the axis, and grow in the inside (*Plantæ Endogenæ*), while the latter produce ligneous substance close under the bark, and deposit it on the inner side, and thus grow on the outside (*Plantæ Exogenæ*). All this had no greater foundation than the fact that in the Monocotyledonous axis the vascular bundles are farther apart in the centre; consequently, in the preponderance of parenchyma, the substance is more lax. It was not ever attempted to make even a superficial observation of the process of growth; if it had been merely observed that the vascular bundles going to the lower leaves, consequently the older, crossed those going to the upper leaves, which must be the younger, a child might have been made to understand at once that a growth of new vascular bundles in the interior was an absolute impossibility. Nevertheless, upon this empty fancy, which a child might have refuted, De Candolle built a grand system of vegetables, which it never did require the distinguished and comprehensive researches of Mohl to overthrow.

"The second notion is that of Du Petit Thouars, which was not less ill-grounded, which, as expressed by him, would be upset by every even the most superficial observation, and even in its more refined subsequent statement is by no means established, but has important and apparently irresistible objections against it. Du Petit Thouars thought that all increase of thickness of the axis resulted from the descent of roots from the buds. Such a crude notion scarcely required refutation. On the other hand, it was afterwards stated that the formless but organisable substance (the cambium) was gradually organised from the buds downwards. The only possible foundation for this view, namely, evidence obtained by thorough investigation of the history of development, is still due from all its assertors, the latest, Gaudichand, &c., included. Therefore it is already to be set aside as devoid of foundation. But the contrary can be made good, that, in the first place, no cambium ever exists as a formless fluid in the plant, unless we would so call the cytoblastema inclosed in the cells; secondly, that, so far as observation at present reaches, cells are always formed in cells, that this cell-formation, according to the observations I have made in the *Cacteæ*, &c., progresses from below upward; thirdly, that the axillary bud is already formed in the terminal bud before the axis begins to increase in thickness, and that certainly the cells of the bud are organised into vascular bundles from the vascular bundles of the stem upward into the bud, and not in the reverse direction. By these remarks the whole notion seems to me to be for the present set aside, and it would require quite other support than that which Gaudichand's imperfect attempts in anatomy and physiology could give it.

"Lastly, I must notice the most recent views of Martius on the structure of the stems of palms, &c. Martius asserts that here the vascular bundles, the primary structure of which is sketched out in the conical terminal bud, on the whole, as I have already explained it (Wiegmann's 'Archiv.,' 1839, 219), do not merely grow upwards into the leaves, but also downward, by their lower end, in the stem. These facts I must entirely oppose from my own observations. Hitherto I have never had an opportunity of investigating living Palms, or more than small fragments of dead ones. But from what I saw I believe I may venture to conclude that the stem of Palms does not essentially deviate in such a way from those of other Monocotyledons, that one may not transfer to the Palms, in the main points, the laws of structure found there. Now, so far as I know, such a process of growth does not occur in any Monocotyledonous plant. According to my observations the newly-produced vascular bundles merely grow continuously upward. In advancing the distinction of limited and unlimited bundles Martius follows me, but in my opinion he has not conceived nearly clearly enough the distinction between developed and undeveloped internodes; and in particular he has not formed a clear conception of the peculiarities of the stem with undeveloped internodes, and the conditions of structure resulting therefrom. Moreover he has left the meaning of the term growth (fortwachsen) of a vascular bundle equivocal. If it means that the already existing elongated cells become transformed into vascular bundles, it describes no peculiar process of growth—the vascular bundles were already to be distinguished in their elementary condition; but if it means that the cells themselves, of which the vascular bundles are composed, are produced subsequently, originating above first and proceeding downwards, this is I believe erroneous. It is necessary to bear in mind the essential distinction between monocotyledonous axes with and without a cambium circle, in order to understand these structures. Where no cambium exists there are no other new cells formed besides those in the point of the bud; but where there is cambium, all development, and so also the development of new vascular bundles in the stem, proceeds upwards and outwards; never, so far as I have been able to observe, downwards or towards the interior. The lowest and innermost cells are always the oldest, never the upper or outer (of course excluding the bark, to which alone an endogenous growth can be ascribed). I must therefore distinctly assert that in the Palms, as in all Monocotyledons, the lower end of an older vascular bundle never reaches down into an internode lower than that in which the lower end of its first rudiment originated."

The following is a summary of the nature of axial structures, and the names given to the various parts of which they are composed:—

1. Duration.

A. Annual. Stem (*Caulis*).
Internodes (*Internodia*).
a. Only existing in the beginning of the period of vegetation, fugacious (*Internodia fugacia*).
b. Enduring the whole period (*Internodia annua*).
c. Only existing in the latter part of the period of vegetation (*Internodia serotina*).
B. Perennial. Trunk (*Truncus*).

2. Position on the Soil.

A. Above ground (*Epigæus*).
B. Under ground (*Hypogæus*).

3. Form.

A. Developed Internodes (*Internodia elongata*).
B. Undeveloped Internodes (*Internodia abbreviata*).
C. Disciform expanded Internodes (*Internodia disciformia*).
D. Concavely expanded Internodes (*Internodia concava*).
N.B. Rigid, pointed, leafless, or defoliated Internodes are called Spines (*Spinæ*); soft, curling, and thus climbing round foreign objects, Tendrils (*Cirrhi, Capreoli*).

4. Various Internodes of the same Axis.

A. Bearing true Leaves and Branches (*Caulis* and *Truncus*).
N.B. Sometimes no leaves are developed (*Axis aphyllus*), or they fall off from the *truncus*, mostly at the end of the first year (*Axis denudatus*). The stem may grow out from the terminal bud of an embryo, as in the simple stem, or out of a trunk. A stem produced from a trunk might be called *Scapus*; but this is a wholly superfluous term.
B. Bearing only bracts, bracteoles, or flowers, Peduncle (*Pedunculi*); in a compound inflorescence the internode bearing a single flower is called the Pedicel (*Pedicellus*). *Receptaculum* is a superfluous expression in the *Synantheræ*. *Pedunculus disciformis, conicus*, &c., is simpler and more correct. Also in *Ficus, Pedunculus concavus*.
C. Internodes between calyx and pistil, Receptacle (*Torus*), e. g. in some *Rosaceæ, Torus disciformis* (in *Potentilla*), *Torus concavus* (in *Rosa*).
a. Internodes between calyx and stamens (e. g. in *Rubus*), or calyx and corolla (e. g. in *Passiflora*), the Disc (*Discus*), e. g. *planus* (in *Geum*), *D. tubulosus* (in *Cereus grandiflorus*).
b. Internodes between corolla and stamens, Androphore (*Androphorum*), e. g. *A. elongatum* (in *Cleome*).
c. Internodes between stamens and pistil, Gynophore (*Gynophorum*), e. g. *G. conicum* (in *Rubus*).
D. Internodes between calyx and seed-buds, as a hollow disc inclosing the seed-buds, Inferior Germen (*Germen inferum*), e. g. in *Synantheræ, Orchidaceæ*.
E. Internodes between stamens and seed-buds, as a plate with the borders curved inward together, in the cavity of which the seed-buds occur, Stalk-Pistil (*Pistillum cauligenum*). In *Liliaceæ* and *Leguminosæ* (?).
F. End of the stalk in the germen, as support of the seeds, Spermophore (*Spermophorum*), in Seed-Buds (*Gemmulæ*). (For the parts of these see below, under the Seed-Bud).

5. As to the Nodes.

A. With Imperfect Nodes (*Caulis, Truncus*).
B. With Perfect Nodes.
a. Stalk (*Culmus*).
b. Stem (*Calamus*).

N.B. It is exceedingly useful to mark this distinction by definite terms: but then we must name the stalk of the *Caryophylleæ*, most *Umbelliferæ* and *Labiatæ*, *Culmus;* the stem of *Bambusa*, *Calamus*, *Piper*, *Aristolochia*, &c., *Calamus*. In other respects the expressions *culmus* and *calamus* have no sense, since it could only be defined as a stalk, such as occurs in the plants to which such a stalk is ascribed, the former in some Grasses, the latter in some *Cyperaceæ*.

6. Different Axes of Compound Plants.

A. Main Axis produced from the terminal bud of the embryo (*Caulis vel Truncus primarius*).

B. Secondary Axis, produced from axillary or adventitious buds (*Caulis vel Truncus secundarius*).

N.B. Still connected with the main axis, called Branch or Twig (*Ramus*).

C. Ramification of the Axis (*Ramificatio*). Ramification of the *Pedunculus* (*Inflorescentia*).

D. Secondary Axis growing along underground, and its secondary axes alone rising above the soil, Root-Stock, Rhizome (*Rhizoma*).

N.B. For Secondary Axes which lie upon the earth, because they are too weak to stand erect, there are some special terms, but these appear to me superfluous:—*Flagellum*, *Stolo*, *Sarmentum*, Runner, Sucker, which are sometimes to be distinguished by the foliation, sometimes by the rooting, now one way and now another, and again may be different from the *Caulis repens*, *humifusus*, *prostratus*, *procumbens*, *decumbens*, *sarmentaceus*, and all the rest of this manufactory of words, aud yet cannot be separated by any characters.

E. It is useful to discriminate, according to the ramification and duration,

a. The simple plant, the lateral buds of which are flowers (*Herbula*) e. g. *Cuscuta*, *Myosurus:*

b. The branched stalk, Herb (*Herba*), e. g. *Anagallis*, *Veronica verna*.

c. With underground stems, stalks above ground, Undershrub (*Suffrutex*), e. g. *Aconitum*, *Napellus*, *Pæonia officinalis*.

d. Stem branched from below, without predominance of the main stem, Bush (*Frutex*), e. g. *Prunus spinosa*, *Juniperus Sabina*.

e. Trunk, the lower branches of which soon die, and which only bears a crown, Tree (*Arbor*), e. g. *Pyrus terminalis*, *Fagus sylvatica*.

N.B. We also reckon among trees those stems also which branch from below upward, but in which the main axis is developed in far the greatest proportion, and may readily be traced to the summit, e. g. *Populus dilatata*, *Abies excelsa*. These might even be called *Arbor fruticosa*.

If the great mass of Exogens are distinctly known from Endogens by their peculiar manner of growth and by the arrangement of their woody matter, they are not less clearly defined by external marks.

Their leaves have the veins ramifying from the midrib, or ribs if there are several, in so intricate a manner as to give the appearance of irregular net-work. Their veins never run parallel with each other without ramifications; for if, as sometimes happens, they appear to do so, it will be found that the appearance is confined to the principal veins or ribs, and that the secondary veins between them ramify in the usual way. The leaves are moreover in most cases articulated with the stem, leaving behind them a clean scar when they die, not rotting away and hanging upon the stem in the form of a ragged sheath, as is common in Endogens. Moreover they are frequently furnished with stipules, an unusual circumstance in Endogens.

The flowers of Exogens are usually constructed upon a quinary type; that is, they have 5 sepals, 5 petals, aud 5 stamens, or some power of that number; now and then they vary to a type of 4, or they exceed the number 5; but we very rarely find the ternary structure of Endogens present in them. If, as in *Anonaceæ*, *Berberaceæ*, and other orders, the sepals and petals follow a ternary type, the number 3 is lost in the stamens or the ovary. The natural order *Menispermaceæ* is the only one among Exogens in which the ternary type regularly pervades all the parts of the flower.

In their manner of growth they rarely resemble Endogens. The consequence of the ramification of the veins is to give their leaves a broad and rounded figure, the effect of which upon their general

Exogenous Vegetation.

appearance is to produce the rounded lumpish aspect that we recognise in all the trees naturally inhabiting this country. In no known instance does the stem grow by the development of a single terminal bud; so that we never find in this class the columnar aspect of palm-trees [GYMNOSPERMS], unless the genus *Theophrasta* be considered an exception. Consequently a landscape consisting of nothing but Exogenous plants would resemble the imaginary sceno that forms the subject of the preceding cut.

The differences between Exogens and Endogens, thus strongly marked in the stem, leaves, and flowers, are connected with others in the embryo. [REPRODUCTION IN PLANTS; SEED.] In Exogens of the commou kind this orgau has two lobes, held together by a minute central body, the upper end of which, between the lobes, is the plumule or rudimentary stem, the lower the radicle or rudimentary root; the lobes themselves, or cotyledons, are rudimentary leaves. This structure is readily seen in a hazel-nut or a garden-bean; the deviations from it are few and unimportant as compared with those of Endogens. Three or a greater number of cotyledons may be present in a whorl, instead of two opposite to each other. Or one of the two cotyledons may be much smaller than the other, as in *Trapa;* or they may be deeply lobed, as in the garden-cress. But in all these cases the deviations are obviously reconcileable with the typical character of being Dicotyledonous.

When the embryo of an Exogen germinates, the radicle simply lengthens at its point, without having to break through the coat of the embryo; on this account Exogens have been named Exorhizal.

The result of this examination is, that the great class of Exogens has five important, and in some measure independent characters, by which its limits are settled.

1. The wood is exogenous.
2. The veins of the leaves are netted.
3. The fructification is formed upon a quinary or quaternary type.
4. The embryo is dicotyledonous.
5. The germination is exorhizal.

Hence Exogens have received two other names in allusion to such characters; they are commonly called *Dicotyledones;* and *Exorhizæ* is another but less common appellation. Moreover, they are the *Phanerocotyledoneæ* of Agardh, the *Anthophytæ* and *Carpophytæ* of Oken's school, the *Dichorgana* of Schultz, the *Phylloblastæ* of Reichenbach; not to mention other names still more obscure.

In consequence of imperfect development, and the abortion or multiplication of parts, mauy deviations occur from the above characters. But as in Endogens, so in these, there is uot in consequence any real difficulty in distinguishing Exogens from other plants. Suppose the stem to be so slightly formed, as in *Podostemaceæ* or the aquatic *Halorageæ*, as not to arrive at a state in which the exogenous arrangement is perceptible, we have the dicotyledonous embryo and the typical number of the floral organs to guide us. Let the leaves appear as scales, as in *Lathræa, Orobanche,* and the like; still there is the embryo or again the floral proportions. If the fructification is absolutely ternary as in *Menispermaceæ*, the organization of the stem, leaves, and embryo reveals the true nature of such plants. Or if the embryo is undivided, as in *Cuscuta*, and at the same time the veins of the leaves deficient, and all this with an incomplete formation of woody matter, then the number of parts iu the flower remains to prevent our falling into error. It is therefore always to be remembered, that the limits of this great class are not exclusively determined by one single character, but by a combination of five; a part of which may be occasionally exceptional or undiscoverable.

Liko all other natural assemblages, Exogens have many analogies with other parts of the vegetable kingdom. We have already adverted to the Podostemaceous order of this class representing distinctly the Pistiaceous order, or at least *Lemna* among Endogens. *Piperaceæ* are distinct analogies here to the *Araceæ* of Endogens, *Chenopodiales* to *Glumosæ*, and possibly *Menispermaceæ* to *Smilaceæ*.

Whatever uses there may be in the vegetable kingdom are to be found in this class, which comprehends four-fifths of the natural orders, and probably not much less than the same proportion of species. Timber, in particular, is their exclusive produce, aud if corn has no direct analogy in Exogens, at least a substitute for it is furnished by the potato and the cassava.

Considering the very great numbers of Exogens—they may be rated at 50,000 or 60,000 at a low computation—it is not surprising that it should be here that the systematic botanist experiences his great difficulties. Comparatively no embarrassment worth notice occurs in the arrangement of Endogens; but in Exogens the difficulties are so great as to have hitherto baffled the most acute writers. We do not mean with regard to the natural orders themselves, for they are in general well understood and defined: our observation applies to a collocation of the orders, or in other words, to the construction of groups of a secondary value which shall be as natural and as well defined as the orders themselves. In a recent enumeration we find no fewer than 231 orders of Exogens. It is obviously impracticable to study so large a number of combinations without breaking them into groups, and accordingly various methods have been proposed.

Jussieu, adopting to a certain extent the views of his predecessors, considered—1st, the separation of the petals, 2nd, their combination, or 3rd, their absence, of primary consequence; and adding to this, 4th, the separation of the sexes in flowers having no petals, he formed the four groups of—1st, Polypetalous; 2nd, Monopetalous; 3rd, Apetalous; and 4th, Diclinous plants. The first three of these he again subdivided accordiug as their stamens or their corolla grew under the ovary (hypogyuous), upon the calyx (perigynous), or upon the ovary (epigynous); then the mouopetalous epigynous group was subdivided into plants having united stamens and those having them distinct; the result being eleveu classes, which were placed by Jussieu in the following order:—

			Class.
Apetalous	Stamens epigynous		1
	Stamens perigynous		2
	Stamens hypogynous		3
Monopetalous	Corolla hypogynous		4
	Corolla perigynous		5
	Corolla epigynous	anthers uuited	6
		anthers distinct	7
Polypetalous	Stamens epigynous		8
	Stamens hypogynous		9
	Stamens perigynous		10
Diclinous			11

This was however so artificial a distribution, that botanists soon found it as unsatisfactory as it was simple. Various changes have therefore been recommended from time to time, some of which are the following:—

In 1813, De Candolle, dropping the names of all Jussieu's classes, and abolishing many of them, proposed to arrange as follows the 113 orders of Exogens with which he was at that time acquainted.

			Class.
Polypetalous	Petals hypogynous (*Thalamifloræ*)		1
	Petals perigynous (*Calycifloræ*)		2
Monopetalous	Corolla perigynous	*Corollifloræ*	3
	Corolla hypogynous		4
Apetalous		(*Monochlamydeæ*)	5

Thus the classes were reduced from eleven to five, which was a defect; but those which remainod were supposed to be more natural, which would have been an advantage. Five years afterwards, in his 'Regni Vegetabilis Systema Naturale,' he added the names inclosed within parentheses, and he broke up the *Thalamifloræ* into five cohorts, but without stating what orders he arranged under them. We do not find that he ever pursued the subject farther. Since that period this great botanist has occupied himself with the special study of the natural orders, and the public has derived no advantage from his general views, which is much to be regretted.

In 1825, Professor Agardh of Lund, afterwards bishop of Carlshad, proposed a great change iu tho subordination of Exogens, retaining the priuciples of primary division recognised by Jussieu and De Candolle, but forming them into twenty subdivisions, defined by various characters analogous to those by which the orders themselves are circumscribed. This, we believe, is the first step of any consequence towards putting Exogens into a more natural grouping than that of Jussieu. In many respects the subdivisions are, as far as they go, unobjectionable; but they have excited scarcely any attention among systematic botanists. The necessity however of some better method of subordination than that of Jussieu and De Candolle has become evident to everybody; and attempts have been made to effect this by Drs. Bartling, Schultz, Von Martius, and others on the continent, and by Dr. Lindley in this country. The last named author has successively developed his system in his 'Nixus Plantarum,' the 'Penny Cyclopædia,' article Exogens, his 'Natural System of Botany,' and his 'Vegetable Kingdom.' We shall here give an analysis of Dr. Lindley's arrangement of Exogens, as given in the last mentioned work. Whatever may be its defects they are rather inherent to the subject than attributable to any want of knowledge or judgment in the author, as it undoubtedly displays the largest acquaintance with the details of the structure of this class of plants that has yet been displayed by any writer on systematic botany. The following is an analysis of the class of Exogens:—

Alliances of Exogeus.

Sub-Class I. Diclinous Exogens.

Flowers ♂ ♀, without any customary tendency to ⚥.

I. AMENTALES.—Flowers in catkins, achlamydeous or monochlamydeous. Carpels superior. Embryo small, with little or no albumen.

Casuarinaceæ.—Ovules 1 or 2, ascending. Radicle superior.
Betulaceæ.—Ovule 1, pendulous. Radicle superior.
Altingiaceæ.—Ovules 00. Seeds winged.
Salicaceæ.—Ovules 00. Seeds cottony.
Myricaceæ.—Ovule 1, erect. Radicle superior.
Elæagnaceæ.—Ovule 1, ascending. Radicle inferior.

II. Urticales. — Flowers scattered, monochlamydeous. Carpel single, superior. Embryo large, lying in a small quantity of albumen.

Stilaginaceæ.—Radicle superior. Ovules twin, suspended. Embryo straight, albuminous. Anthers 2-lobed, with vertical fissures.

Urticaceæ.—Radicle superior. Ovule solitary, erect. Embryo straight, albuminous. Juice limpid. Stipules small, flat.

Ceratophyllaceæ.—Radicle inferior. Embryo exalbuminous. Plumule many-leaved, large.

Cannabinaceæ.—Radicle superior. Ovule solitary, suspended. Embryo hooked, exalbuminous.

Moraceæ.—Radicle superior. Ovules solitary, suspended. Embryo hooked, albuminous.

Artocarpaceæ.—Radicle superior. Ovule solitary, erect or suspended. Embryo straight, exalbuminous. Juice milky. Stipules large, convolute.

Platanaceæ.—Radicle inferior. Embryo albuminous. Plumule minute. Juice limpid. Stipules large, deciduous.

III. Euphorbiales.—Flowers scattered, monochlamydeous. Carpels consolidated, superior. Placentæ axile. Embryo surrounded by abundant albumen. (Albumen occasionally absent.)

Euphorbiaceæ.—Ovules definite, suspended, anatropal. Radicle superior.

Gyrostemoneæ.—Ovules definite, suspended, campylotropal. Radicle inferior. Albumen mealy.

Scepaceæ.—Ovules definite, suspended, anatropal. Radicle superior, ♂, amentaceous.

Callitrichaceæ.—Ovules definite, suspended, amphitropal. Radicle superior.

Empetraceæ.—Ovules definite, ascending, anatropal. Radicle inferior.

Batideæ.—Ovules solitary, ascending, ♀, naked, combined into a succulent cone.

Nepenthaceæ.—Ovules 00, ascending. Radicle inferior. Seeds scobiform.

IV. Quernales. — Flowers in catkins, monochlamydeous. Carpel single, superior. Embryo large, lying in a small quantity of albumen.

Corylaceæ.—Ovary 2- or more celled. Ovules pendulous or peltate.

Juglandaceæ.—Ovary 1-celled. Ovule solitary, erect.

V. Garryales. — Flowers monochlamydeous, sometimes amentaceous. Carpels inferior. Embryo minute, in a large quantity of albumen.

Garryaceæ.—Flowers amentaceous. Leaves opposite, stipulate.

Helwingiaceæ.—Flowers fascicled. Leaves alternate, stipulate.

VI. Menispermales. — Flowers monochlamydeous. Carpels superior, disunited. Embryo surrounded by abundant albumen.

Monimiaceæ.—Albumen copious, solid. Seeds pendulous. Embryo small, external. Stamens perigynous.

Atherospermaceæ.—Albumen copious, solid. Seeds erect. Anthers opening by recurved valves.

Myristicaceæ.—Albumen copious, ruminated. Sepals united into a valvate cup.

Lardizabalaceæ.—Albumen copious, solid. Seeds parietal. Embryo minute.

Schizandraceæ.—Albumen copious, solid. Seeds pendulous. Embryo minute, internal. Stamens hypogynous.

Menispermaceæ.—Albumen sparing, solid. Seeds amphitropal. Embryo large.

VII. Cucurbitales.—Flowers monochlamydeous. Carpels inferior. Placentæ parietal. Embryo without albumen.

Cucurbitaceæ.—Fruit pulpy. Placentæ strictly parietal. Monopetalous.

Datiscaceæ.—Fruit dry. Placentæ strictly parietal. Apetalous.

Begoniaceæ.—Fruit dry. Placentæ projecting and meeting in the axis. Monodichlamydeous.

VIII. Papayales.—Flowers dichlamydeous. Carpels superior, consolidated. Placentæ parietal. Embryo surrounded by abundant albumen.

Papayaceæ.—Corolla monopetalous; ♀, without scales.

Pangiaceæ.—Corolla polypetalous; ♀, with scales in the throat.

Sub-Class II.—Hypogynous Exogens.

Flowers ☿, or ♂ ☿ ♀. Stamens entirely free from the calyx and corolla.

IX. Violales.—Flowers monochlamydeous. Placentæ parietal, or sutural. Embryo straight, with little or no albumen.

Flacourtiaceæ.—Flowers scattered, apetalous, or polypetalous. Petals and stamens both hypogynous. Leaves dotless, or with round dots only.

Lacistemaceæ.—Flowers in catkins, apetalous, scaly, polygamous. Stamens unilateral.

Samydaceæ.—Flowers scattered, apetalous, tubular, hermaphrodite. Leaves marked with both round and linear transparent dots. Stamens perigynous.

Passifloraceæ.—Flowers polypetalous or apetalous, coronetted. Petals perigynous, imbricated. Stamens on the stalk of the ovary. Styles simple, terminal. Seeds arillate. Leaves stipulate.

Malesherbiaceæ.—Flowers polypetalous, coronetted. Petals perigynous, imbricated. Stamens on the stalk of the ovary. Styles simple, dorsal. Seeds without aril. Leaves without stipules.

Moringaceæ.—Flowers polypetalous. Calyx many-leaved. Petals perigynous. Anthers 1-celled. Fruit stipitate, consolidated, siliquose. Seeds without albumen. Stamens perigynous.

Violaceæ.—Flowers polypetalous. Calyx many-leaved. Petals hypogynous. Stamens all perfect. Anthers crested and turned inwards. Fruit consolidated. Seeds albuminous.

Frankeniaceæ.—Flowers polypetalous. Calyx tubular, furrowed. Petals hypogynous, unguiculate.

Tamaricaceæ.—Flowers polypetalous. Calyx many-leaved. Petals hypogynous. Styles distinct. Fruit consolidated. Seeds 00, basal, comose, without albumen.

Sauragesiaceæ.—Flowers polypetalous. Calyx many-leaved. Petals hypogynous. Stamens partly sterile and petaloid. Anthers opposite; the petals naked, turned outwards. Fruit consolidated. Seeds albuminous.

Crassulaceæ.—Flowers polypetalous or monopetalous. Calyx many-leaved. Petals hypogynous. Fruit follicular, apocarpous.

Turneraceæ.—Flowers polypetalous. Petals perigynous, contorted. Styles forked. Leaves exstipulate.

X. Cistales.—Flowers monochlamydeous. Placentæ parietal or sutural. Embryo curved or spiral, with little or no albumen.

Cistaceæ.— Stamens not tetradynamous, generally indefinite. Flowers ⅘ or ⅘. Seeds with albumen. Fruit closed up.

Brassicaceæ.—Stamens tetradynamous. Flowers ⁴⁄.

Resedaceæ.—Stamens not tetradynamous, definite. Flowers not tetramerous. Seeds without albumen. Fruit usually open at the point.

Capparidaceæ.—Stamens not tetradynamous. Flowers 4. Seeds without albumen. Fruit closed up.

XI. Malvales. — Flowers monochlamydeous. Placentæ axile. Calyx valvate in æstivation. Corolla imbricated or twisted. Stamens definite or 00. Embryo with little or no albumen.

Sterculiaceæ.—Stamens columnar, all perfect. Anthers 2-celled, turned outwards.

Byttneriaceæ.—Stamens monadelphous, in most cases partly sterile. Anthers 2-celled, turned inwards.

Vivianiaceæ.—Stamens free. Disc none. Seeds with albumen. Embryo curved. Petals permanent. Calyx ribbed.

Tropæolaceæ.—Stamens free. Disc none. Seeds without albumen. Embryo amygdaloid.

Malvaceæ.—Stamens columnar, all perfect. Anthers 1-celled, turned inwards.

Tiliaceæ.—Stamens free, on the outside a disc. Seeds with albumen. Embryo straight.

XII. Sapindales. — Flowers monochlamydeous, unsymmetrical. Placentæ axile. Calyx and corolla imbricated. Stamens definite. Embryo with little or no albumen. Stamens rarely 00.

Tremandraceæ.—Flowers complete, partially symmetrical. Calyx valvate. Anthers 2-4-celled, opening by pores.

Polygalaceæ.—Flowers complete (irregular) unsymmetrical. Petals naked. Anthers opening longitudinally. Carpels 3. Seeds winged. (In one case the ovary is adherent.)

Vochyaceæ.— Flowers complete, unsymmetrical, very irregular. Petals naked. Anthers opening longitudinally. Carpels 3. Seeds winged.

Staphyleaceæ.—Flowers complete, unsymmetrical. Petals usually with an appendage or 0. Anthers opening longitudinally. Carpels 3. Seeds usually arillate, wingless.

Sapindaceæ.—Flowers complete, unsymmetrical. Petals usually with an appendage or 0. Anthers opening longitudinally. Carpels 3. Seeds usually arillate, wingless.

Petiveriaceæ.—Flowers apetalous. Carpels solitary.

Aceraceæ.—Flowers complete, unsymmetrical. Petals naked or 0. Anthers opening longitudinally. Carpels 2. Seeds without an aril.

Malpighiaceæ.—Flowers complete, partially symmetrical. Calyx imbricated. Petals naked, stalked. Ovules hanging by cords. Stigmas simple. Embryo usually convolute.

Erythroxylaceæ.—Flowers complete, partially symmetrical. Calyx imbricated. Petals with an appendage. Ovules sessile, pendulous. Stigmas capitate. Embryo straight.

XIII. Guttiferales. — Flowers monochlamydeous. Placentæ axile. Calyx imbricated. Corolla imbricated or twisted. Stamens 00. Embryo with little or no albumen. Stamens sometimes definite in number.

Dipteraceæ.—Leaves simple, alternate, with large convolute stipules. Flowers symmetrical. Petals equilateral. Calyx unequal, permanent, winged. Anthers beaked. Fruit 1-celled; 1-seeded.

Ternstromiaceæ.—Leaves simple, alternate, without stipules, or with very small ones. Flowers symmetrical. Petals equilateral. Anthers versatile. Seeds few or single. Stigmas on a long style.

Rhizobolaceæ.—Leaves digitate, opposite. Flowers symmetrical. Petals equilateral. Stigmas sessile. Seeds solitary. Embryo with an enormous radicle.

Clusiaceæ.—Leaves simple, opposite, without stipules. Flowers symmetrical. Petals equilateral. Anthers adnate, beakless. Seeds solitary or few. Stigmas sessile, radiating.

Marcgraviaceæ.—Leaves simple, alternate, without stipules. Flowers unsymmetrical. Petals equilateral. Anthers versatile. Seeds innumerable, minute. Stigmas sessile.

Hypericaceæ.—Petals oblique, glandular. Seeds numerous, naked. Styles long, distinct.

Reaumuriaceæ.—Petals oblique, glandless. Seeds few, shaggy. Styles long, distinct.

XIV. Nymphales.—Flowers dichlamydeous. Placentæ axile or sutural. Stamens 00. Embryo on the outside of a very large quantity of mealy albumen. A part have no albumen.

Nymphæaceæ—Carpels united into a many-celled fruit, with dissepimental placentæ.

Cabombaceæ.—Carpels distinct. Albumen copious. Torus absent.

Nelumbiaceæ.—Carpels distinct. Albumen 0. Torus honeycombed, very large.

XV. Ranales.—Flowers monodichlamydeous. Placentæ sutural or axile. Stamens 00. Embryo minute, inclosed in a large quantity of fleshy or horny albumen.

Magnoliaceæ.—Carpels distinct. Stipules large, convolute. Corolla imbricated. Albumen homogeneous.

Anonaceæ.—Carpels distinct. Stipules 0. Corolla valvate. Albumen ruminate.

Dilleniaceæ.—Carpels distinct. Stipules 0. Corolla imbricated. Albumen homogeneous. Seeds arillate.

Ranunculaceæ.—Carpels distinct. Stipules 0. Corolla imbricated. Albumen homogeneous. Seeds without an aril.

Sarraceniaceæ.—Carpels consolidated. Calyx permanent. Placentæ axile.

Papaveraceæ.—Carpels consolidated. Calyx deciduous. Placentæ usually parietal.

XVI. Berberales.—Flowers monodichlamydeous. Placentæ sutural, parietal, or axile. Stamens definite. Embryo inclosed in a large quantity of fleshy albumen.

Droseraceæ.—Flowers regular and symmetrical. Placentæ parietal. Stamens alternate with the petals, or twice as many.

Fumariaceæ.—Flowers irregular and unsymmetrical. Placentæ parietal. Stamens opposite the petals.

Berberidaceæ.—Flowers regular, symmetrical. Placentæ sutural. Stamens opposite the petals. Anthers with recurved valves.

Vitaceæ.—Flowers regular, symmetrical. Placentæ axile. Stamens opposite the petals. Anthers opening longitudinally.

Pittosporaceæ.—Flowers regular, symmetrical. Placentæ axile and parietal. Stamens alternate with the petals. Ovules ascending or horizontal. Corolla imbricated.

Olacaceæ.—Flowers regular, symmetrical. Placentæ axile. Stamens alternate with the petals. Ovules pendulous. Corolla valvate.

Cyrillaceæ.—Flowers regular, symmetrical. Placentæ axile. Stamens alternate with the petals, if equal to them in number. Ovules pendulous. Corolla imbricated.

XVII. Ericales.—Flowers dichlamydeous, symmetrical in the ovary. Placentæ axile. Stamens definite. Embryo inclosed in a large quantity of fleshy albumen. Stamens occasionally adherent to the corolla.

Humiriaceæ.—Flowers polypetalous. Stamens all perfect, monadelphous. Anthers 2-celled, with a long membranous connective.

Epacridaceæ.—Flowers monopetalous. Stamens all perfect, free. Seeds with a firm skin. Anthers 1-celled, opening longitudinally.

Pyrolaceæ.—Flowers half-monopetalous. Stamens all perfect, free. Seeds with a loose skin. Embryo at the base of the albumen.

Francoaceæ.—Flowers polypetalous. Stamens half-sterile and scale-like, free. Seeds with a firm skin.

Monotropaceæ.—Flowers half-monopetalous. Stamens all perfect, free. Seeds with a loose skin or wing. Embryo at the apex of the albumen.

Ericaceæ.—Flowers monopetalous. Stamens all perfect, free. Seeds with a firm or loose skin. Anthers 2-celled, opening by pores.

XVIII. Rutales.—Flowers monodichlamydeous, symmetrical. Placentæ axile. Calyx and corolla imbricated, if present. Stamens definite. Embryo with little or no albumen. Occasionally ♂ ♀.

Aurantiaceæ.—Fruit consolidated, succulent, indehiscent. Petals imbricated. Stamens free, or nearly so. Leaves dotted.

Amyridaceæ.—Fruit consolidated, hard, dry, somewhat valvular. Petals valvate. Stamens free. Leaves generally dotted.

Cedrelaceæ.—Fruit consolidated, capsular. Stamens deeply monadelphous or free. Seeds numerous, winged.

Meliaceæ.—Fruit consolidated, berried, or capsular. Stamens deeply monadelphous. Seeds few, wingless. Leaves dotless.

Anacardiaceæ.—Fruit apocarpous. Ovule single, suspended by a cord rising from the base of the carpel.

Connaraceæ.—Fruit apocarpous. Ovules collateral, ascending, orthotropal, sessile.

Rutaceæ.—Fruit finally apocarpous, few-seeded, with the pericarp separating in two layers. Ovules sessile, pendulous. Flowers ⚥.

Xanthoxylaceæ.—Fruit finally apocarpous, 1-seeded, with the pericarp separating in two layers. Ovules sessile, pendulous. Flowers ♂ ⚥ ♀.

Ochnaceæ.—Fruit finally apocarpous, 1-seeded, with the pericarp not laminating, and a succulent conical torus.

Simarubaceæ.—Fruit finally apocarpous, 1-seeded, with the pericarp not laminating, and a dry inconspicuous torus. Albumen wanting. Leaves alternate, without stipules.

Zygophyllaceæ.—Fruit finally apocarpous, few-seeded, with the pericarp not laminating, and a dry inconspicuous torus. Albumen present. Leaves opposite, with stipules.

Elatinaceæ.—Fruit finally apocarpous, many-seeded. Flowers polypetalous.

Podostemaceæ.—Fruit finally apocarpous, many-seeded. Flowers apetalous, very imperfect.

XIX. Geraniales.—Flowers monodichlamydeous, symmetrical. Placentæ axile. Calyx imbricated. Corolla twisted. Stamens definite. Embryo with little or no albumen.

Linaceæ.—Flowers symmetrical. Styles distinct. Carpels longer than the torus. Seeds with little or no albumen.

Chlænaceæ.—Flowers regular, unsymmetrical, with a permanent cup-like involucre. Stamens monadelphous. Albumen abundant.

Oxalidaceæ.—Flowers symmetrical. Styles distinct. Carpels longer than the torus. Seeds with abundant albumen.

Balsaminaceæ.—Flowers very irregular and unsymmetrical, without an involucre. Stamens distinct. Albumen none.

Geraniaceæ.—Flowers usually symmetrical. Styles and carpels combined round a long-beaked torus.

XX. Silenales.—Flowers monodichlamydeous. Placentæ free, central. Embryo external, curved round a little mealy albumen. Carpels more than one, completely combined into a compound fruit. Some slightly perigynous, others ♂ ♀.

Caryophyllaceæ.—Calyx and corolla usually both present and symmetrical (4 and 4, or 5 and 5), the latter conspicuous. Ovules amphitropal. Leaves opposite, without stipules.

Illecebraceæ.—Calyx and corolla usually both present and symmetrical (4 and 4, or 5 and 5), the latter rudimentary. Ovules amphitropal. Leaves with scarious stipules.

Portulacaceæ.—Calyx and corolla both present and unsymmetrical (2 and 5), the latter usually conspicuous. Ovules amphitropal. Leaves alternate, succulent, without stipules.

Polygonaceæ.—Calyx only present, but often coloured. Ovules orthotropal. Nut usually triangular.

XXI. Chenopodales.—Flowers monochlamydeous. Placentæ free, central. Embryo external, either curved round or applied to the surface of a little mealy or horny albumen. Carpels solitary, or if more than one distinct. Some slightly perigynous, others ♂ ♀.

Nyctaginaceæ.—Sepals united into a long (often coloured) plaited tube which separates from its base, the latter becoming hard, and forming a spurious pericarp.

Phytolaccaceæ.—Sepals separate, flat. Stamens alternate with the sepals, or 00. Carpels several (or 1).

Amarantaceæ.—Sepals separate or nearly so, flat. Stamens opposite the sepals. Anthers often 1-celled. Ovary 1; often several-seeded. Flowers scarious, surrounded by imbricated bracts.

Chenopodiaceæ.—Sepals separate or nearly so, flat. Stamens opposite the sepals. Anthers 2-celled. Ovary 1; always 1-seeded. Flowers herbaceous, naked.

XXII. Piperales.—Flowers achlamydeous. Embryo minute, on the outside of a large quantity of mealy albumen. Occasionally ♂ ♀.

Piperaceæ.—Carpel solitary. Ovule erect. Embryo lying in vitellus. Leaves opposite or alternate, with or without stipules.

Chloranthaceæ.—Carpel solitary. Ovule suspended. Embryo naked. Leaves opposite, with intermediate stipules.

Saururaceæ.—Carpels several, distinct. Ovule erect. Embryo lying in vitellus. Leaves alternate with stipules.

Sub-Class III. Perigynous Exogens.

Flowers ⚥ or ♂ ⚥ ♀. Stamens growing to the side of either the calyx or corolla. Ovary superior, or nearly so.

XXIII. Ficoidales.—Flowers monodichlamydeous. Placentæ central or axile. Corolla, if present, polypetalous. Embryo external, and curved round a small quantity of mealy albumen.

Basellaceæ.—Petals absent. Sepals distinct. Fruit inclosed in a membranous or succulent calyx. Carpel single, solitary. Seed erect.

Mesembryaceæ.—Petals numerous, conspicuous. Carpels several, consolidated.

Tetragoniaceæ.—Petals absent. Carpels several, consolidated.

Scleranthaceæ.—Petals absent. Sepals united into a tube. Carpel single, solitary. Fruit inclosed in the hardened calyx tube.

XXIV. Daphnales.—Flowers monodichlamydeous. Carpel solitary. Embryo amygdaloid, without albumen.

Thymelaceæ.—Anthers bursting lengthwise. Apetalous or polypetalous. Ovule solitary, suspended. Calyx imbricated.

Proteaceæ.—Anthers bursting lengthwise. Apetalous. Ovules erect. Calyx valvate.

Lauraceæ.—Anthers bursting by recurved valves. Leaves perfect. Fruit naked.

Cassythaceæ.—Anthers bursting by recurved valves. Leaves mere colourless scales. Fruit buried in a succulent permanent calyx.

XXV. Rosales.—Flowers monodichlamydeous. Carpels more or less distinct. Placentæ sutural. Seeds definite. Corolla, if present, polypetalous. Embryo amygdaloid, with little or no albumen.

Calycanthaceæ.—Flowers consisting of numerous imbricated scales. Cotyledons convolute.

Chrysobalanaceæ.—Flowers polypetalous (or apetalous), nearly or quite regular. Carpel solitary. Style proceeding from the base of the ovary.

Fabaceæ, or *Leguminosæ*. — Flowers polypetalous or apetalous, paphoriaceous (or leguminous). Carpel solitary, with the style proceeding from the apex of the ovary.

Drupaceæ.—Flowers polypetalous, regular, drupaceous. Carpel solitary, with the style proceeding from the apex of the ovary.

Pomaceæ.—Flowers polypetalous, regular. Carpels adhering to the calyx by their back.

Sanguisorbaceæ.—Flowers apetalous. Carpel solitary, inclosed in a hardened calyx-tube, forming a false pericarp.

Rosaceæ.—Flowers polypetalous. Carpels free from the calyx, and quite or nearly so from each other.

XXVI. Saxifragales.—Flowers monodichlamydeous. Carpels consolidated. Placentæ sutural or axile. Seeds 00. Corolla, if present, polypetalous. Embryo taper, with a long radicle, and little or no albumen.

Saxifragaceæ.—Styles distinct. Leaves alternate.

Hydrangeaceæ.—Styles distinct. Leaves opposite, without stipules.

Cunoniaceæ.—Styles distinct. Leaves opposite, with large interpotiolar stipules.

Brexiaceæ.—Styles consolidated. Calyx many-leaved. Albumen 0. Leaves alternate.

Lythraceæ.—Styles consolidated. Calyx tubular, permanent, with the petals in the margin. Albumen 0. Leaves opposite.

XXVII. Rhamnales.—Flowers monodichlamydeous. Carpels consolidated. Placentæ axile. Fruit capsular, berried, or drupaceous. Seeds definite. Embryo amygdaloid, with little or no albumen.

Penæaceæ.—Flowers apetalous. Ovary composed of 4 carpels. Calyx tubular, with definite divisions. Cotyledons consolidated.

Aquilariaceæ.—Flowers apetalous. Ovary composed of 2 carpels. Calyx tubular, with a definite number of divisions. Cotyledons amygdaloid.

Ulmaceæ.—Flowers apetalous. Ovary composed of 2 carpels. Calyx imperfect, and irregularly divided at the edge. Cotyledons thin and leafy.

Rhamnaceæ.—Flowers polypetalous. Calyx valvate. Stamens opposite petals. Seeds erect.

Chailletiaceæ.—Flowers polypetalous. Calyx valvate. Stamens alternate with the petals. Seeds pendulous.

Hippocrateaceæ.—Flowers polypetalous. Calyx imbricated. Stamens (3), monadelphous.

Celastraceæ.—Flowers polypetalous. Calyx imbricated. Stamens ⅘, distinct.

Stackhousiaceæ.—Flowers monopetalous. Stamens episepalous.

Sapotaceæ.—Flowers monopetalous. Stamens epipetalous. Ovules ascending. Radicle short. Cotyledons amygdaloid.

Styracaceæ.—Flowers monopetalous. Stamens epipetalous. Ovules in part at least suspended. Radicle long. Cotyledons leafy.

XXVIII. Gentianales. — Flowers dichlamydeous, monopetalous, symmetrical. Placentæ axile or parietal. Embryo minute, or with the cotyledons much smaller than the radicle, lying in a large quantity of albumen.

Ebenaceæ.—Stipules 0. Stigmas simple, sessile, radiating.

Aquifoliaceæ.—Stipules 0. Stigmas simple, at the end of a manifest style. Placentæ axile. Seeds definite, pendulous. Corolla imbricated.

Apocynaceæ.—Stipules 0. Stigmas collected into a massive head, expanded at the base in the form of a ring or membrane, and contracted in the middle. Albumen sometimes 0.

Loganiaceæ.—Leaves opposite, with intervening stipules.

Diapensiaceæ.—Stipules 0. Stigmas simple, at the end of a manifest style. Placentæ axile. Seeds indefinite, peltate. Stamens interpetalous.

Stilbaceæ.—Stipules 0. Stigmas simple, at the end of a manifest style. Placentæ axile. Seeds definite, erect. Corolla valvate. Flowers unsymmetrical.

Orobanchaceæ.—Stipules 0. Stigmas simple, at the end of a manifest style. Placentæ parietal. Flowers didynamous.

Gentianaceæ.—Stipules 0. Stigmas simple, at the end of a manifest style. Placentæ parietal. Flowers regular.

XXIX. Solanales.—Flowers dichlamydeous, monopetalous. Placentæ axile. Fruit 2-3-celled. Embryo large, lying in a small quantity of albumen.

Oleaceæ.—Stamens free, 2 or 4.

Solanaceæ.—Stamens free, 5. Placentæ axile. Embryo terete.

Asclepiadaceæ.—Anthers and stigmas consolidated into a column.

Cordiaceæ.—Stamens free, 5. Placentæ axile. Cotyledons leafy, folded longitudinally.

Convolvulaceæ.—Stamens free, 5. Placentæ basal. Cotyledons leafy, doubled up.

Cuscutaceæ.—Stamens free, 5. Placentæ basal. Embryo filiform, spiral.

Polemoniaceæ.—Stamens free, 5. Placentæ axile. Cotyledons straight, plano-convex.

XXX. Cortusales.—Flowers dichlamydeous, monopetalous, symmetrical. Placentæ free. Central embryo lying among a small quantity of albumen. Occasionally monochlamydeous or polypetalous.

Hydrophyllaceæ.—Stamens alternate with the petals. Styles 2. Inflorescence circinate.

Plumbaginaceæ.—Stamens opposite the petals. Fruit membranous, 1-seeded. Styles 5. Stem herbaceous.

Plantaginaceæ.—Stamens alternate with the petals. Style 1. Inflorescence straight.

Primulaceæ.—Stamens opposite the petals. Fruit capsular, many-seeded. Style 1. Stem herbaceous.

Myrsinaceæ.—Stamens opposite the petals. Fruit indehiscent, drupaceous. Style 1. Stem woody.

XXXI. Echiales.—Flowers dichlamydeous, monopetalous, symmetrical or unsymmetrical. Fruit nucamentaceous, consisting of several 1-seeded nuts, or of clusters of them separate or separable. Embryo large, with little or no albumen. (Very rarely hypogynous.) Regular-flowered orders passing from Solanals.

Jasminaceæ.—Flowers regular, ⅔, unsymmetrical. Stamens 2. Fruit 2-lobed. Stigma naked.

Salvadoraceæ.—Flowers regular, symmetrical. Stamens 4. Fruit simple. Stigma naked.

Ehretiaceæ.—Flowers regular, symmetrical. Stamens 5. Stigma naked. Nuts 4. Confluent inflorescence circinate.

Nolanaceæ.—Flowers regular, symmetrical. Stamens 5. Nuts 5 or ⅘. Stigma naked. Inflorescence straight.

Boraginaceæ.—Flowers regular, symmetrical. Stamens 5. Nuts 4 or ⅔. Stigma naked. Inflorescence circinate.

Brunoniaceæ.—Flowers regular, symmetrical. Nut solitary. Stigma indusiate. (Stamens hypogynous.) Irregular-flowered. Orders passing into Bignoniads.

Lamiaceæ.—Flowers irregular, unsymmetrical. Nuts 4. Ovule erect.

Verbenaceæ.—Flowers irregular, unsymmetrical. Nuts confluent. Ovules erect.

Myoporaceæ.—Flowers irregular, unsymmetrical. Nuts confluent. Ovules pendulous. Anthers 2-celled.

Selaginaceæ.—Flowers irregular, unsymmetrical. Nuts confluent. Ovules pendulous. Anthers 1-celled.

XXXII. Bignoniales.—Flowers dichlamydeous, monopetalous, unsymmetrical. Fruit capsular or berried, with its carpels quite consolidated. Placentæ axile or parietal, or free central. Embryo with little or no albumen.

Pedaliaceæ.—Placentæ parietal. Fruit bony or capsular. Embryo amygdaloid. Radicle short.

Gesneraceæ.—Placentæ parietal. Fruit capsular or baccate. Embryo with minute cotyledons. Radicle long.

Crescentiaceæ.—Placentæ parietal. Fruit succulent, hard-shelled. Embryo amygdaloid. Radicle short.

Bignoniaceæ.—Placentæ axile. Seeds winged, sessile, without albumen. Cotyledons large, leafy.

Acanthaceæ.—Placentæ axile. Seeds wingless, attached to hard placental processes, without albumen. Cotyledons large, fleshy.

Scrophulariaceæ.—Placentæ axile. Seeds albuminous. Cotyledons scarcely larger than or not so large as the radicle.

Lentibulariaceæ.—Placentæ free. Central seeds minute, without albumen. Cotyledons much smaller than the radicle.

Sub-Class IV. Epigynous Exogens.

Flowers ⚥ or ♂ ⚥ ♀. Stamens growing to the side of either the calyx or corolla. Ovary inferior, or nearly so.

XXXIII. Campanales.—Flowers dichlamydeous, monopetolous. Embryo with little or no albumen.

Campanulaceæ.—Ovary 2 or more celled. Anthers free, or half united. Stigma naked. Corolla valvate, regular.

Lobeliaceæ.—Ovary 2 or more celled. Anthers syngenesious. Stigma surrounded by hairs. Corolla valvate, irregular.

Goodeniaceæ.—Ovary 2 or more celled. Anthers syngenesious or free. Stigma indusiate. Corolla induplicate.

Stylidiaceæ.—Ovary 2 or more celled. Stamens and styles united into a column. Corolla imbricated.

Valerianaceæ.—Ovary 1-celled. Corolla imbricated. Anthers free. Ovule pendulous. Albumen none.

Dipsacaceæ.—Ovary 1-celled. Corolla imbricated. Anthers free. Ovule pendulous. Seeds albuminous.

Calyceraceæ.—Ovary 1-celled. Corolla valvate. Anthers syngenesious. Ovule pendulous. Seeds albuminous.

Asteraceæ.—Ovary 1-celled. Corolla valvate. Anthers syngenesious. Ovule erect. Albumen none.

XXXIV. Myrtales.—Flowers dichlamydeous, polypetalous. Placentæ axile. Embryo with little or no albumen. (Occasionally monochlamydeous.)

Combretaceæ.—Ovary 1-celled. Ovules pendulous. Leaves dotless. Seeds without albumen. Cotyledons convolute.

Alangiaceæ.—Ovary 1-celled. Ovules pendulous. Leaves dotless. Seeds albuminous. Cotyledons flat.

Chamælauciaceæ. — Ovary 1-celled. Ovules ascending. Leaves dotted. Embryo fused into a solid mass.

Haloragaceæ.—Ovary with more than 1 cell. Flowers polypetalous or apetalous. Calyx open, minute. Stamens definite. Ovules pendulous. Cotyledons minute. (Occasionally 1-celled.)

Onagraceæ.—Ovary with more than 1 cell. Flowers polypetalous or apetalous. Calyx valvate. Stamens definite. Ovules horizontal or ascending. Cotyledons flat, much larger than the radicle.

Rhizophoraceæ.—Ovary with more than 1 cell. Flowers polypetalous. Calyx valvate. Stamens indefinite. Cotyledons flat, much shorter than the radicle, which germinates before the fruit falls.

Belvisiaceæ.— Ovary with more than one cell. Flowers monopetalous, coronated. Calyx valvate. Stamens indefinite, monadelphous. Cotyledons amygdaloid.

Melastomaceæ.—Ovary with more than 1 cell. Flowers polypetalous. Calyx imbricated. Stamens definite. Anthers rostrate. Leaves usually dotless.

Myrtaceæ.—Ovary with more than 1 cell. Flowers polypetalous or apetalous (or valvate). Calyx imbricated. Stamens 00. Anthers oblong. Leaves usually dotted.

Lecythidaceæ.—Ovary with more than 1 cell. Flowers polypetalous. Calyx valvate or imbricated. Stamens 00, in part collected into a fleshy hood. Anthers oblong. Leaves dotless.

XXXV. Cactales.—Flowers dichlamydeous, polypetalous. Placentæ parietal. Embryo with little or no albumen.

Homaliaceæ.—Sepals and petals distinct. Stamens opposite the petals. Styles separate. Ovules pendulous.

Loasaceæ.—Sepals and petals distinct. Stamens scattered. Styles confluent. Ovules pendulous. Seeds albuminous.

Cactaceæ.—Sepals and petals numerous, indistinguishable. Stamens scattered. Styles confluent. Ovules horizontal. Seeds without albumen.

XXXVI. Grossales.—Flowers dichlamydeous, polypetalous. Seeds numerous, minute. Embryo small, lying in a large quantity of albumen.

Grossulariaceæ.—Fruit pulpy. Placentæ parietal.

Escalloniaceæ.—Fruit capsular. Pacentæ axile. Style and stamens definite. Calyx imbricated.

Philadelphaceæ.—Fruit capsular. Placentæ axile. Styles disunited. Stamens 00. Calyx valvate.

Barringtoniaceæ.—Fruit pulpy or fibrous. Placentæ axile. Style 1. Stamens 00. Calyx imbricated.

XXXVII. Cinchonales. — Flowers dichlamydeous, monopetalous. Embryo minute, lying in a large quantity of albumen.

Vacciniaceæ.—Stamens epigynous. Anthers opening by pores.

Columelliaceæ. — Stamens epipetalous, bursting longitudinally. Anthers sinuous. Flowers unsymmetrical.

Cinchonaceæ. — Stamens epipetalous, bursting longitudinally. Anthers straight. Leaves with interpetiolar stipules.

Caprifoliaceæ. — Stamens epipetalous, bursting longitudinally. Anthers straight. Fruit consolidated. Leaves without stipules.

Galiaceæ.—Stamens epipetalous, bursting longitudinally. Anthers straight. Fruit didymous. Leaves verticillate, without stipules.

XXXVIII. Umbellales.—Flowers dichlamydeous, polypetalous. Seeds solitary, large. Embryo small, lying in a large quantity of albumen.

Apiaceæ.—Fruit didymous, with a double epigynous disc.

Araliaceæ.—Fruit not didymous, without a double epigynous disc, 3 or more celled. Pentamerous flowers. Corolla valvate. Leaves alternate, without stipules. Anthers turned inwards, opening lengthwise.

Cornaceæ.—Fruit not didymous, without a double epigynous disc, 2 or more celled. Tetramerous flowers. Corolla valvate. Leaves opposite, without stipules.

Hamamelidaceæ.—Fruit not didymous, without a double epigynous disc, 2-celled. Corolla imbricated. Leaves alternate, with stipules. Anthers with deciduous valves.

Bruniaceæ.—Fruit not didymous, without a double epigynous disc, 3- (or 1-) celled. Corolla imbricated. Leaves alternate, without stipules. Anthers turned outwards, opening lengthwise.

XXXIX. Asarales.—Flowers monochlamydeous. Embryo small, lying in a large quantity of albumen.

Santalaceæ.—Ovary 1-celled. Ovules definite, with a coated nucleus.

Loranthaceæ.—Ovary 1-celled. Ovules definite, with a naked nucleus.

Aristolochiaceæ.—Ovary 3-6-celled. Ovules 00.

On this arrangement Dr. Lindley makes the following general remarks :—

"The office of reproduction is, after that of sustaining life, the most essential in the economy of plants and animals, and therefore the modifications which are found in the organs of reproduction may be expected to furnish the best characters for classification, after those of nutrition. The latter have been already employed as the foundations of the classes, as far as they appear susceptible of being so applied; the former, consisting of the stamens and pistil, have been little used for the classes, and appear to present as many modifications as are required for secondary divisions. That was the opinion of Linnæus, who adopted them in the construction of the classes and orders of his sexual system; but he mainly relied upon their number, which is a circumstance of little or no importance, and where that was done his classification proved useless; but in those parts of the system in which he made use of other circumstances, as in his *Monadelphia*, *Diadelphia*, *Tetradynamia*, *Didynamia*, *Syngenesia*, &c., his divisions ceased wholly or in part to be artificial, and although in some instances modified, still correspond essentially with the natural orders of modern botanists. Nor did the importance of the stamens and pistil escape the keen eye of Jussieu, who relied upon them very much in the construction of his ingenious system. In the first place he separated from all other Exogens those which have the stamens in one flower and the pistil in another, and he called them Diclinous, and by this process he brought together a collection of natural orders corresponding with the Monœcious and Diœcious plants of Linnæus. No one can doubt that this was a judicious step, and upon the whole the plants collected in the Diclinous division resemble each other more than they resemble anything else; but he excluded a large number of truly Diclinous plants, which are scattered over other parts of his classification, and this has led to the idea that the distinction itself was a bad one, an opinion in which I formerly concurred; but a more careful examination of it since, and an extensive acquaintance with the vegetable kingdom, has entirely convinced me that we have no available characters for breaking up Exogens into primary groups, or sub-classes, superior to those of separated and united sexes, that is to diclinism and hermaphroditism. Not that they are without exceptions; to employ the forcible language of Jussieu himself:—'Ut in præcedente serie nonnullas diclinis hermaphroditis commixtas plantis admittit exceptæ, sic in diclinum ordines quædam irrepunt hermaphroditæ; consentiente aut jubente naturâ, quæ stabiliores interdum eludit regulas, nonuunquam instabilis ipsa aut abstrusis legibus obtemperans.' ('Gen. Pl.' 384.) But if what are called polygamous plants, that is to say, such as have a rudimentary pistil in the male flowers, and rudimentary stamens in the female flowers, are regarded as being hermaphrodite, as they surely are, and the idea of a diclinous structure is limited to cases of a total separation of the stamens and the pistil, these exceptions are reduced to a small and unimportant number of no moment in a classification. For this reason then the Diclinous sub-class of Jussieu is still preserved and increased by modern discoveries, and improved by the expulsion of such plants as *Piper*, *Gnetum*, *Ulmus*, and others, which belong to hermaphrodite orders, or have other affinities than those suggested by Jussieu. In this way Exogens are broken up into two groups, the one Diclinous and the other Hermaphrodite. The latter is divided by almost everybody into Polypetalous, Monopetalous, and Apetalous sub-classes, following the old systematists who knew of little beyond external characters, and had small acquaintance with any plants except those of Europe. But all experience shows, what reason seems to indicate, that no great natural combinations can be effected by such distinctions. Exceptions to the constancy of such characters are endless; there is probably not one polypetalous order that is not also apetalous, and many of them are even monopetalous, of which Rueworts, Houseleeks, Anonads, Leguminous plants, Milkworts, and many more afford familiar examples. The apetalous orders are occasionally polypetalous, as in many genera of Buck-Wheats and Daphnad's. The monopetalous structure becomes polypetalous in all but a very few cases, even indeed in such natural orders as the Primworts; and it even disappears altogether, as in Oliveworts and

Primworts. Nor is it probable that characters derived from the calyx and corolla should be of the very highest value; for in the first place those organs are physiologically identical, their distinction having no real existence except in certain special instances; and in the next place the importance of them to the act of reproduction can hardly be considerable, when we find that plants are multiplied quite as well in their absence as in their presence, and even that, as in the Violet, some Leguminous plants, the common Apple, &c., which habitually produce them, seeds are matured as freely when they are partially away as when in a state of high development. For this reason the calyx and corolla are here rejected as organs suited for distinguishing the primary groups, or the sub-classes of Exogens. We are not however justified in assuming that the calyx and corolla are never of any high importance in plants, and therefore, while they are objectionable as forming the basis of a classification per se, they are recognised as having a real value in connection with the stamens. If the stamens have no adhesion to either calyx or corolla, then it may be assumed that the latter organs may be dispensed with, and for this reason the first sub-class of hermaphrodite Exogens is characterised by the stamens standing entirely clear of the floral envelopes, or being, in the language of Jussieu, hypogynous. But if there is any adhesion between the stamens and either the calyx or corolla, it may equally be assumed that the one organ is in some way necessary to the other; for this reason the perigynous character is admitted as a valid mark of a sub-class; not however a slight and inappreciable adhesion, but a real and manifest union of the parts; and it is considered immaterial whether the stamens grow on the petals or the calyx, provided they grow on one of them.

"Beyond this we have that further degree of adhesion, to which Jussieu gave the name of Epigynous, consisting of a union not only of the calyx or corolla to the stamens, but of all those organs to the sides of the ovary. This, in which it may be supposed that a higher degree of necessity for the incorporation of the floral organs exists than in the former case, is taken as the distinctive mark of a third sub-class of hermaphrodite Exogens, so that the sub-classes are established on the following grounds:—

Flowers absolutely unisexual . . .	I. DICLINOUS.
Flowers hermaphrodite:—	
Stamens not adhering to either calyx or corolla	II. HYPOGYNOUS.
Stamens adhering to either calyx or corolla	III. PERIGYNOUS.
Stamens, calyx, and corolla all adhering to the side of the ovary	IV. EPIGYNOUS.

"This it may be said is essentially the old plan of Jussieu; but there is this material difference between the method now proposed and that of the great chief of the French school; that what he treated as a secondary character is made primary; while his primary distinction of polypetalous, monopetalous, and apetalous structure is treated quite as a subordinate consideration, as it surely deserves to be. If the classification thus obtained be attentively studied it will be found to offer many entirely new combinations, while others of universally recognised truth are not disturbed by it. Of these new combinations there are few to which any serious objection seems to apply, and it is believed that the larger part of them are more opposed to our prejudices than to truth. Not that I have the presumption to suppose that they will meet the universal approval of botanists. What method of classification ever has or ever can be? So long as there are points of view from which a survey may be taken of the vegetable kingdom, so long will there be conflicting opinions as to the way in which the objects that meet the eye can best be grouped.

"In former attempts at redistributing the natural orders of Exogens, I had proposed to throw into one sub-class all those in which the embryo is very small, as compared with the albumen in which it is imbedded, and I still think that this peculiarity is of as much importance among plants as the being oviparous or viviparous among animals. But although I do not at present see a reason for retracting my former opinion on that subject, yet I do see that the time is hardly come for carrying out such a principle satisfactorily; and therefore, instead of employing it for the character of a sub-class, it has only been used as a means of limiting alliances.

"Although, from the complicated nature of the affinities of plants, no hope can be reasonably entertained of securing an unbroken line of transition from one end to the other of the series in which the various groups must necessarily be treated of, yet it will be found that the method here proposed offers very few considerable gaps in the chain of relationship.

"Commencing with the Amental Alliance, which seems to stand in near relation to the Joint Firs (*Gnetaceæ*), among Gymnosperms, the passage to the Urtical and Euphorbial is too plain to require explanation; of the latter the Quernal and Garryal may be regarded as epigynous, forming the first without albumen, the second with an abundance of it. Nutmegs in the Menispermal Alliance then fit in; and the twining Menispermads may be taken as an aticipation of Cucurbitals, of which the Papayal Alliance is an offset a little out of the direct line of succession. Even to the latter however an analogue is found among Violals, in the form of Bixads and Samyds; thence Turnerads conduct us directly into the Cistal Alliance.

"At this point we quit the debateable ground of affinities, and passing necessarily through Malvals, Sapindals, and Guttiferals, we reach the Nymphal Alliance through Tutsans. Here however the chain is evidently broken, and probably the sequence is wrong. The Water-Shields (*Cabombaceæ*), among Nymphals, pass directly into the Ranal Alliance by way of the Crow-Foots, whence Poppy-Worts join Fume-Worts in the Berberal Alliance. At this place Cyrillads appear to form a connecting link with Humiriads among Ericals, and the latter pass directly into the Rutal Alliance by the intervention of such plants as *Correa*. From Rutals the passage is easy to the Geranial, Sileual, and Chenopodal Alliances, which suddenly stop with the Peppers; this is however a doubtful case of affinity, although such a plant as *Batis* may seem to justify the approximation. At the point now reached the perigynous sub-class is penetrated by way of the Ficoidal Alliance, which might be almost united with the Chenopodal. Scleranths, among Ficoidals, seem to present a transition to Salvadorads in the Daphnal Alliance, of which again a part of the Rosal Alliance is almost a polypetalous form. From Rosals to Saxifragals, and then by way of *Brexia* to Rhamnads, is but a step. At this point the Gentianal Alliance is entered by way of Holly-Worts, and we quit it by moving from Gentian-Worts into the Solanal Alliance. The Cortusal, Echial, and Bignonial Alliances may be passed without any obstacle, and thus we reach the end of the perigynous sub-class. Gesner-Worts in the Bignonial Alliance fit on to Goodeniads, among the Campanals, of the epigynous sub-class. These join Myrtals through Myrobalans on the one hand, and Napoleon-Worts on the other. From Myrtals we pass to the Cactal Alliance, which may be theoretically considered a parietal condition of the former, so near do the Onagrads of the former approach the Loasads of the latter group. This brings us to Barringtoniads and other orders collected in the Grossal Alliance. The Cinchonals are entered by way of Bilberry-Worts, and quitted through the Stellate plants, which evidently touch Umbellifers in the Umbellal Alliance. At this point a passage is effected into the last alliance, that of Asarals, by way of Witch-Hazels and Sandal-Worts, till the whole line is finally closed by the Birth-Worts. These singular plants with their ternary flowers seem to have an uncontestable relationship to Yams among Dictyogens, and thus the circle of affinities eventually returns into itself.

"Each of the sub-classes consists of alliances which have also in many instances a strong lateral relation; so that in order to obtain a clear idea of their mutual correspondence it is necessary to place them side by side as well as in succession. This is very obvious in the following instances:—

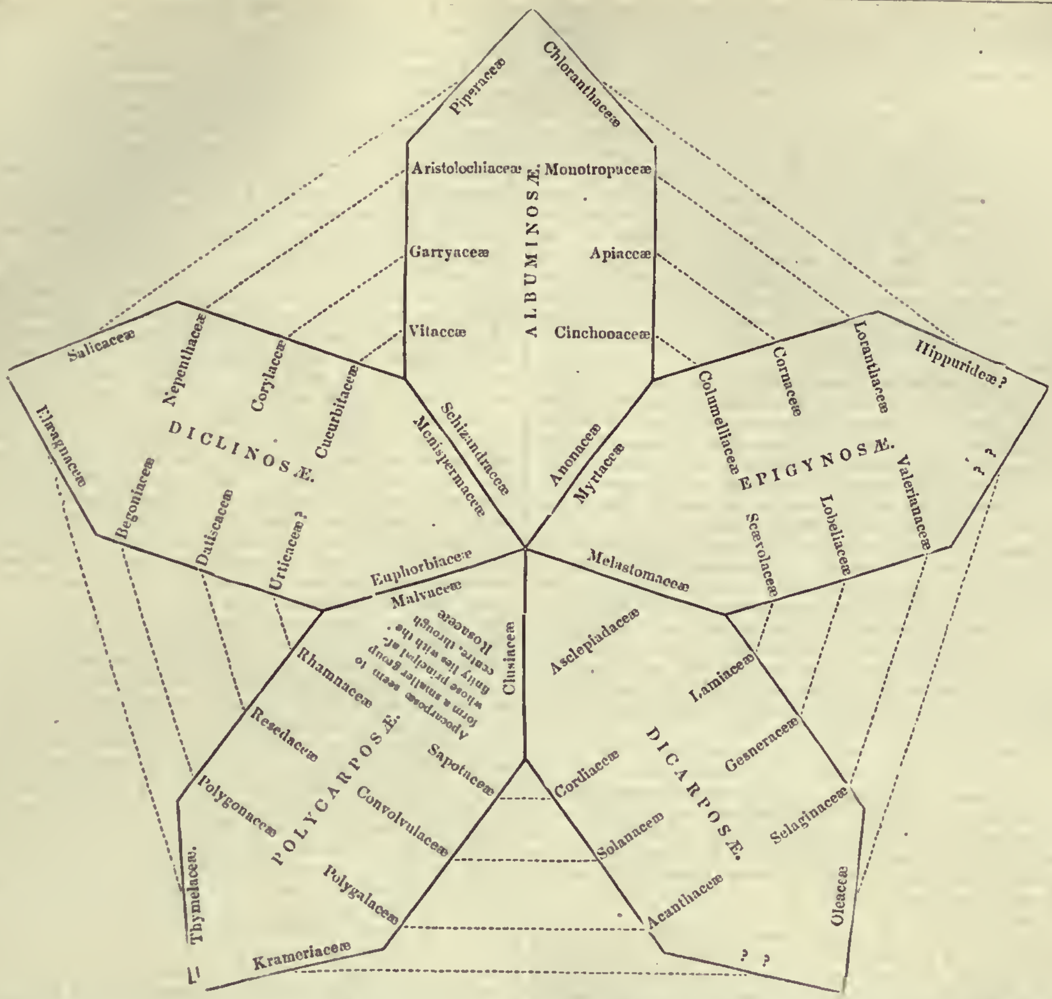
Diclinous.	Hypogynous.	Perigynous.	Epigynous.
Urticales . . .	*Chenopodales* .	*Ficoidales* . . .	
Euphorbiales . .	*Malvales* . .	*Daphnales* . . .	
Menispermales .	*Ranales* . . .	*Saxifragales* . .	*Myrtales.*
Cucurbitales . .	*Violales* . . .	*Bignoniales* (*Crescentia*). . .	*Campanales.*

"This abundantly shows how hopeless it is to express the real affinities of plants by any other means than a map or some such contrivance, and that all sequences will of necessity be inadequate to explain in any considerable degree the position in which natural orders really stand with relation to each other."

An attempt at arranging the orders according to the system then adopted by Dr. Lindley, was made in the 'Penny Cyclopædia;' and we subjoin it on the next page as a specimen of how complicated affinities may be expressed upon a flat surface. A series of irregular solid spheres would perhaps express the affinities of the orders better.

That these groups are all perfect in themselves, or nearly so, is sufficiently proved by *Albuminosæ*, the sequence of whose orders may be expressed as follows; the orders included in the diagram being marked with *:—

1. *Anonales.*—*Magnoliaceæ*
   Winteraceæ
   Dilleniaceæ
   Berberaceæ
   **Anonaceæ*
   Monimiaceæ
   Atherospermaceæ
   Myristicaceæ
   **Schizandraceæ*
2. *Ranales.*—*Nymphæaceæ*
   Hydropeltideæ
   Nelumbiaceæ
   Ranunculaceæ
   —*Podophylleæ*
   Papaveraceæ
   —*Fumarieæ*
   Francoaceæ (?)
   Sarraceniaceæ
   Cephalotaceæ
   Droseraceæ
3. *Primulales.*—*Primulaceæ*
   Myrsinaceæ
   Ebenaceæ (?)
   Aquifoliaceæ (?)
4. *Gentianales.*—*Apocynaceæ*
   Spigeliaceæ
   Gentianaceæ
5. *Loganiales.*—*Loganiaceæ*
   Potaliaceæ
6. *Cinchonales.*—*Caprifoliaceæ*
   **Cinchonaceæ*
   Lygodysodeaceæ
   Galiaceæ
7. *Umbellales.*—**Apiaceæ*
   Araliaceæ
8. *Pittosporales.*—**Vitaceæ*
   Olacaceæ
   Pittosporaceæ
9. *Grossales.*—*Grossulaceæ*
   Bruniaceæ
   Escalloniaceæ
10. *Lathræales.*—*Pyrolaceæ*
    **Monotropaceæ*
    (?) *Orobanchaceæ* (?)
11. . . . .—**Garryaceæ*
12. . . . .—**Aristolochiaceæ*
13. *Piperales.*—**Piperaceæ*
    Saururaceæ
    **Chloranthaceæ*



For further information on the subject of natural arrangements the student should consult Dr. Lindley's 'Vegetable Kingdom.'

EXORHIZÆ. [EXOGENS.]

EXO'STEMMA (from ἔξω, without, and στέμμα, a crown) a genus of Plants belonging to the natural order *Cinchonaceæ*. It has an obovate 5-toothed calyx; a corolla with a terete tube, and a 5-parted limb with linear segments; the anthers linear, exserted; the capsule crowned by the calyx, dehiscing from the apex through the dissepiments into two half-fruits; the seeds girded by a membranous entire border. The species are trees or shrubs, with lanceolate oval short-stalked leaves, and stipules solitary on each side of the petioles.

E. Caribæum, Quinquina Piton, Sea-side Beech, has ovate-lanceolate acuminated glabrous leaves; axillary 1-flowered pedicles, rather shorter than the petioles; the calyx bluntly 5-toothed; the style and stamens about equal in length to the corolla. It is a tree about twenty feet high, and a native of the Caribbee Islands, Guadaloupe, St. Domingo, Jamaica, Santa Cruz, and Mexico. This plant is the *Cinchona Caribæa* of Jacquin and the *C. Jamaicensis* of Wright. The capsules before they are ripened are very bitter, and produce a burning itching when applied to the nostrils and lips. The bark is also bitter, and possesses a tonic, febrifuge, and emetic action on the system, but it does not appear to have either quinine or cinchonine in its composition. The bark is generally smooth and gray on the outside. Its flavour, according to Dr. Wright, is at first sweet, with a mixture of the taste of horse-radish and aromatic oils, but afterwards it becomes excessively bitter and disagreeable. When examined by the microscope it presents innumerable shining crystalline points, which, according to Guibourt, are some principle peculiar to the bark.

E. floribunda, Quinquina of St. Lucia, has elliptic acuminated glabrous leaves; peduncles terminal, corymbose; flowers smooth; the teeth of the calyx short, acute; the capsules turbinate. It is a native of the West India islands, among woods by the side of torrents. It is the *Cinchona floribunda* of Swartz; *C. Sanctæ Luciæ* of David, *C. montana* of Badier, and *C. Luciana* of Vittmann. The bark is similar to the last, and used as a substitute for the Peruvian bark, but Pelletier and Caventou discovered no quinine or cinchonine in any part of the plant.

E. Souzanum, Quinquina de Piauhi, has leaves obovate or ovate, acute, smooth; the corymbs few, flowered, terminal; the capsules scarcely an inch long, obovate, compressed, the valves usually 4-nerved; the seeds transversely oblong, with a broad wing all round. This plant is a native of Brazil, and is used as a substitute for the Peruvian bark. Buchner found in it an alkaloid, which he called Esenbeckine, on the supposition that this plant was an *Esenbeckia*. The alkaloid was probably cinchonine.

E. Peruvianum is the *Cinchona Peruviana* of Poiret. It has ovate-oblong acute leaves, rounded at the base, the upper sessile and cordate. It is a tree ten or twelve feet high, and grows in the colder parts of Peru, on the declivities of the Andes, between the river Chota and the village of Querocotillo, 3000 feet above the level of the sea. The bark is very bitter, and has a sweetish taste, with a nauseous smell. There are several other species of *Exostemma*, which have also been used as cinchona barks, but the above are those which are best known.

(Don, *Dichlamydeous Plants;* Lindley, *Flora Medica;* Bischoff, *Medicinisch-Pharmaceutische Botanik.*)

EYE. The organs appropriated to the sense of sight are distributed very extensively, yet with that frugality which always regulates the operations of nature in the construction of animals. All the active species which live in the light are furnished with them; the rest are disqualified to possess as well as to profit by them, by their limited powers of locomotion, or by constant residence in the dark. In conformity with this rule, to which there are few if any exceptions, these organs are occasionally associated with the lowest types of animal development, and are sometimes absent in the highest. Thus some radiated animals, most of the articulated tribes, and many of the mollusca, have manifest organs of vision, and some of them are of the most curious and artificial construction; on the other hand, the mole and the shrew-mouse, both vertebrated animals, and belonging to the highest order of that class, the mammalia, are blind. They have eyes, it is true; but those of the mole are not larger than the head of a pin, and are unprovided with optic nerves; and the equally imperfect eye of the shrew is covered with skin, from which hair grows as on the rest of the body. Hence, even in the absence of further evidence, we might conclude that if these animals have any perception of light, it can only be sufficient to warn them back to their haunts when by any accident they emerge to the day. But it is more probable that they do not see at all; and that these rudimentary organs, like the male nipple, exist only in conformity with the general model of vertebrated construction.

The structural peculiarities of the eye, as well as the presence of that organ, may be inferred with more certainty from the circumstances of an animal than from the place it occupies in any zoological scale: in fact, no part has a closer relation to the habits and mode of existence. The eye may be simple or compound, single or multiplied, fixed or moveable: it may be encased in a hard transparent shell; or lie deeply imbedded within the protection of a bony socket; or project from the surface of the head at the extremity of a sensitive and retractile horn: it may be adapted for near or distant, oblique or direct, vision; for seeing in a strong or a weak light, in a dense or in a rare medium; or it may be formed so as to accommodate itself to each of these conditions in its turn; and these peculiarities will all be found upon examination to be in strict accordance with the exigencies of the animal. Mere difference in bodily size, and the proportionate reduction or increase in the bulk of the eye, is sufficient to constitute a reason for a difference in its structure, and may suggest an explanation when such discrepancies are observed to exist in animals otherwise alike.

Yet with all the varieties in configuration to which we have alluded, it is rather in form than in substance that the eyes of animals differ from each other. The organ has always a common purpose, and is essentially the same in all cases: that is, we find an assemblage of the same fundamental parts, generally arranged in the same order, even when our powers of observation are assisted by the microscope, and until all traces of organisation are lost in extreme tenuity of texture and the transparency which results from it. And although there are refinements in the structure of the organ of which we do not know the purpose, and certain delicate adjustments in the exercise of the faculty of which we do not know the instruments, yet upon the whole we can deduce the principles upon which the eye is constructed, and assign the uses of its several parts with great certainty from our knowledge of optical and physiological laws.

The human eye is the most complete type of this organ, and the structure and functions of the human eye will be here more particularly described, with occasional remarks upon the structure of the eyes of the lower animals.

The object, or what may be called the general problem, of the human eye, is to combine distinctness and extent of vision with the security and maintenance of the organ, and the utmost convenience in using it. The parts associated for these purposes are the orbits, or sockets, of the eye; the optic nerve; the eyeball, or globe, with its contents, and the external muscles which move and suspend it; the eyelids; the lachrymal apparatus; the nerves and vessels which supply these parts, and the mass of fatty and cellular substance which isolates and supports them.

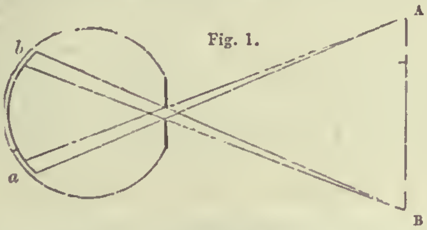
Orbits.—The eyes with their appendages are lodged in two symmetrical roomy cavities in the skull, completed in front by the eyelids, but elsewhere entirely circumscribed by bone, the office of which it need hardly be said is to protect them from injury, and from any pressure that might embarrass the perfect freedom and precision of their movements. These cavities are called the Orbits, Orbital Fossæ, or Sockets of the eye. Seven bones of the cranium or face, which we need not enumerate, enter into the composition of each. They are separated from each other in their whole depth, which is about two inches, by the posterior chambers of the nose. They are conical in shape, or, more strictly speaking, pyramidal, and obscurely quadrangular. The apex is directed backwards; the base, about an inch and a quarter in width, is directed forwards, with a considerable inclination outwards or towards the temple. The margin is less prominent at the outer side than elsewhere, so that when viewed laterally it presents a wide semicircular notch, with the concavity forwards. One object of the divergence of the orbits, and of this retreating curvature of the outer margin, is obviously to increase the extent of vision. If the point of the finger be held before the eye, and carried gradually back towards the ear, it will be observed that in consequence of this arrangement it can be seen long after it has got behind a vertical plane touching the front of both eyes, which taken together are thus enabled to sweep over an angle of about 320°, or 20° on each side behind the tangent plane. Above and below, the edge is undercut as well as prominent, and the socket is therefore a little wider within than at the margin itself, so that it slightly overhangs the eyeball at these points. The inner or nasal sides pass directly backwards and are parallel to each other, and the roof is horizontal; consequently the conical form of the cavity arises from the inclination of the outer side and floor. In the angle between these sides, and in that between the first and the roof, there are two long irregular slits. The former opens into the deep hollow between the temple and the back of the upper jaw; it is called the foramen lacerum inferius, or spheno-maxillary fissure, and gives passage to a branch from the fifth pair of nerves, which, piercing the bone, passes beneath the floor of the orbit, and emerges upon the cheek through a hole just beneath the lower edge of the orbit, about a third part from the inner angle of the eye. The other slit, which is called the sphenoidal fissure, or foramen lacerum superius, opens into the cavity of the head, and transmits another branch of the fifth pair, which passing within the orbit along the roof comes out through an opposite notch in its upper margin, and is distributed upon the forehead and upper lid. These branches of the fifth pair, called the supra and infra-orbitary nerves, are the most frequent seats of that excruciating affliction the tic-douloureux. Through the sphenoidal fissure are likewise transmitted the ophthalmic veins, and all the other nerves except the optic destined to the eye and its appendages. A third opening, which is circular, called the foramen opticum, of the size of a large quill, and leading also from the cavity of the skull, gives passage through the sphenoid bone to the ophthalmic artery and the optic nerve. It is directed obliquely outwards and forwards, and is situated at the apex or back part of the orbit, in the angle between the nasal side and the roof. In the same angle, close to the margin, that is, just within the corner of the eye near the nose, there is a deep groove leading into the lachrymal canal, to which we shall have occasion to recur hereafter.

Optic Nerves.—The Optic Nerves, arising at the back part of the brain, with which they have extensive and important connections, not only where they seem to originate in the corpora quadrigemina, but throughout the whole of the first part of their course within the cranium, pass horizontally forward above the floor of that cavity, converging towards each other till they meet, when they become closely united. It is probable that they not merely meet but cross each other, the greater part, if not the whole, of the nerve from the right side of the brain going to the left eye, and vice versâ. It has been ingeniously supposed by Dr. Wollaston ('Phil. Trans.,' 1824), in order to account for some singular phenomena of disordered and healthy vision, that this decussation or crossing takes place only with respect to those parts of each nerve which lie towards the other; so that each supplies the outer half of one eye and the inner half of the other. This he conceives would explain, among other things, the correspondence between the homologous points of the two eyes, which may be defined as those points which see the same object at the same time. It is scarcely possible to verify such speculations by dissection, from the softness and apparent homogeneity of the parts. In fish the optic nerves cross each other entirely without touching; and in man, when the sight of one eye has been lost, the nerve beyond the point of union within the cranium has been observed to be wasted or diseased on the side opposite to that of the affected eye. [BRAIN; NERVE.] Beyond the point of junction the nerves again diverge from each other, and passing into the optic foramen become invested in a tough, flexible, and fibrous sheath, which is a tubular production of the strong membrane called the dura mater which lines the cavity of the skull. The outer part of this sheath is reflected off as the nerve enters the orbit, and expanding, adheres to the bony surface of that cavity throughout, becoming its periosteum. The nerves, continuing to diverge, reach the eyeball after a somewhat tortuous course of an inch in length. The curvature and laxity of the optic nerve give facility to the movements of the globe, and preserve the delicate structures within it as well as the nerve itself from the injurious effects of tension. Its length is such as to allow the eyeball to project slightly beyond the edge of the socket in front, and to afford space behind for the action of the muscles which move it, and a suitable distance between their points of attachment. Including the thickness of the sheath, it is about one-sixth of an inch in diameter. It does not consist like other nerves of a bundle of distinct fibres, but of a medullary pulp inclosed in minute transparent tubes. The sheath is pierced half an inch from the globe by a vessel called the arteria centralis retinæ, which accompanied by several small veins reaches the axis of the nerve, and passes with it into the interior of the eye. The nerve does not enter the back of the globe exactly in the axis of vision, but about the fifth part of an inch from it, in a horizontal line, on the inner or nasal side, and subtending an angle of about 23° at the centre of the eye. At this point the dimensions of the sheath are suddenly contracted, and it terminates in a thin cul-de-sac pierced with minute holes or pores, hence called the lamina cribrosa (sieve-like plate). Through these pores the pulp of the nerve, divested of its tubular involucra, passes into the interior of the globe in divided portions; but immediately re-uniting expands at the back of the eye into a delicate cup-shaped membrane, with the concavity directed forwards. This expansion of the optic nerve is called the Retina; it is the most important part of the eye, having a peculiar and exclusive sensibility to the impressions of light, of which immediate notice is conveyed from it along the collected nerve to the brain. All other parts of the mechanism of vision are subordinate to this; and their whole office, independently of the conservation of the organ as a part of a living body, is to regulate the quantity of light admitted into the eye, and to distribute it in such a way upon the surface of the retina that the impression, which if immediately received would be confused and general, may be an exact counterpart of the visible surface of the object.

Mechanism of Distinct Vision.—The most elementary fact that we know respecting light is, that it proceeds in straight lines or rays from every point of a luminous or illuminated body. A sensitive surface or retina presented nakedly to such a body would therefore intercept innumerable cones or pencils of light, each diverging from a different point of the object. But each point of the retina must also be considered in that case as the apex of a cone of rays converging upon it from every part of the object; and it is manifest that the various impressions thus received upon the same point at the same time would be undistinguishable from each other. All therefore that we can conceive to be communicated to the mind by the sum of such indefinite impressions over the whole retina, is a knowledge of the prevailing colour of the object, and possibly a general idea of its direction. But if there were more objects than one, or that one had parts or magnitude, even this inconsiderable addition to the mere sense of light and colour would be impossible. The confusion resulting from the simultaneous impressions of a multitude of pencils of light on the same surface would be partly removed if the seat of perception were placed at the bottom of a cavity capable of being turned to each object or each part of the same object in succession, inasmuch as this would prevent the interference of rays proceeding from parts not actually under contemplation; but an indistinctness would still remain in proportion to the magnitude of the field of view, only remediable by narrowing the cavity to a merc-capillary tube, upon the inconvenience of which we need not enlarge.

Let us consider what would be the effect of a very simple addition to the cavity. We will suppose it to be closed in front by a dark screen, perforated with a small central hole as in the section represented in *fig.* 1.

Fig. 1.

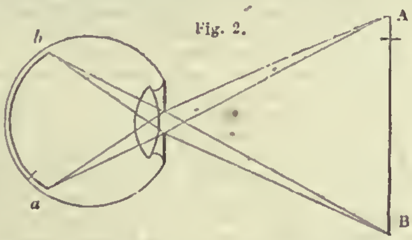


In this case pencils of rays crossing each other from A and B, the top and bottom of an object, would impinge at *a* and *b* upon different parts of the retina. By this means the advantages of a large and a small field of view would be combined, a distributed impression of the object would be produced, and its several parts would be seen separately and in their proper relative situations. The effect may be easily shown by holding a card, pierced with a smooth circular hole, near a taper, and throwing the spectrum upon a wall at a little distance. Such a screen is termed the Iris.

But still the rays from each point of the object would be diffused over a space instead of being collected upon a separate point of the surface, and the impressions of contiguous pencils would in some degree overlap and confuse each other. This inconvenience might be lessened by contracting the opening, but another cause of indistinctness would then be introduced in the diminished admission of light.

Both evils might be avoided if a lens of a proper construction were fixed behind the screen (as in *fig.* 2). Pencils diverging from single points of the object would thus be admitted through the opening, which we will call the Pupil, and would be made to converge to single points on the surface, and the impression would now be an exact counterpart of the object, A being distinctly seen in its true place and direction from *a*, and B from *b*.

Fig. 2.



But additional provisions would be necessary to bring this arrangement to the requisite degree of perfection. In the first place the retina must be adjusted to correspond in shape with the focal distance of the lens. This purpose might be accomplished if the walls of the cavity were composed of flexible materials, by interposing a transparent fluid between the lens and the retina, which, by its uniform distension, would constrain the latter to take and retain the form of a portion of a sphere.

Again, although the diagram has been otherwise drawn for an obvious reason, our arrangement hitherto supposes the object to be very small, and to be seen directly in front of the eye; but if oblique as well as direct pencils are to be brought to a focus, that the lateral vision may be also distinct, a second refracting body, of a proper form, must be placed in front of the lens. This may be done very conveniently, with the further advantage of completing the cavity, by adding a transparent portion to its walls in front of the screen, to be likewise distended with fluid in order to keep it in the shape of a segment of a sphere. (*Fig.* 3.)

It is also desirable that the back of the screen and the interior of the cavity should be blackened, that the rays may be extinguished after impact upon the retina, lest any internal reflection should interfere with the impressions on other parts. The expediency of this provision is always kept in view in the construction of optical instruments, and may be made evident by looking at a bright object through a polished metal tube. The colouring-matter is called the Pigmentum Nigrum, or simply the Pigment. [PIGMENT.]

Fig. 3.

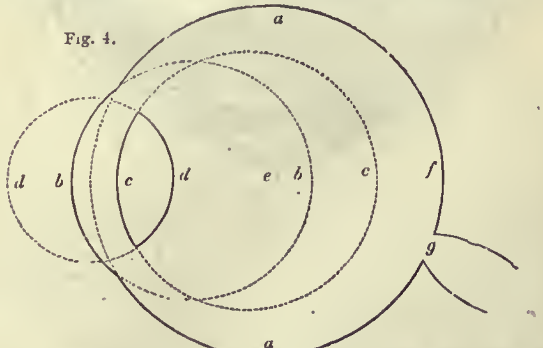
The only remaining artifice to secure the perfection of the organ that need be mentioned in this synopsis of its most essential provisions, is to endow the pupil with the faculty of contraction and enlargement according to the quantity of light. If it were of a constant size, more light would be concentrated upon the retina from a bright or a near object than from one comparatively distant or faintly illuminated; and as the sensibility of the retina must remain the same, the disproportion would occasion dimness of sight in one case and dazzling in the other, and might even impair the nerve.

We have thus imagined all the parts to be built up in succession that are of primary importance (as far as we know) in the construction of an organ of distinct vision, and the figure to which we have arrived might pass as a tolerably correct diagram of the human eye.

The laws of light and sensation require that there should be a general type in the structure of these parts, and a mutual relation among them as to density, form, and position. But this does not preclude much variety; a difference of position, for instance, may be, and frequently is, compensated by a corresponding difference in form or density either of the same or other parts. Hence the problem of distinct vision has many solutions, each perfect in its kind. In fact, nothing can be more diversified in unimportant particulars, or more uniform in those which are essential, than the interior constitution of the eye in different animals: it is never precisely the same in any two species, however closely they may be allied; but we constantly find the retina, the lens, and the pigment, and generally the iris, inclosed of course in some kind of capsule, transparent in front, and partly occupied by complementary fluids. To this there are some exceptions, which however we believe to be only apparent. Thus the larvæ of many insects, some of the microscopic animalcules, and species of *Mollusca*, have red or black spots upon their surface, which are undoubtedly eyes, and are thought by some to be little more than expansions of an optic nerve beneath a thin coloured membrane to absorb the light, and in some unknown way to distribute its impressions; whilst others consider them as a congeries of extremely minute but perfectly-formed eyes of the usual construction, of which the pigment alone is visible from its opacity and abundance.

Globe.—The Globe, or Eyeball, contains the parts immediately concerned in vision. It consists of very unequal portions of two spheres of a different size, which have a common circular intersection in a transverse vertical plane, much nearer the front than the back of the eye. The iris, or coloured screen, perforated centrally by the pupil, nearly occupies the situation of this imaginary plane, but is, strictly speaking, behind it. The posterior and larger portion is circumscribed by the sclerotic membrane, except in front, where it may be considered as bounded by the iris: it is rather less than an inch in diameter, and constitutes about five-sixths of the surface of the globe. (*Fig.* 4, *a.*) The included space is occupied by the choroid membrane and retina, the vitreous and crystalline humours, the ciliary body and processes, and a small part of the aqueous humour. The anterior portion, which forms about a quarter of a sphere, thirteen-twentieths of an inch in diameter (*fig.* 4, *b*), and occupies the remaining sixth

Fig. 4.



Section of the spherical surfaces of the human eye, twice the natural size the circles completed in dotted lines.

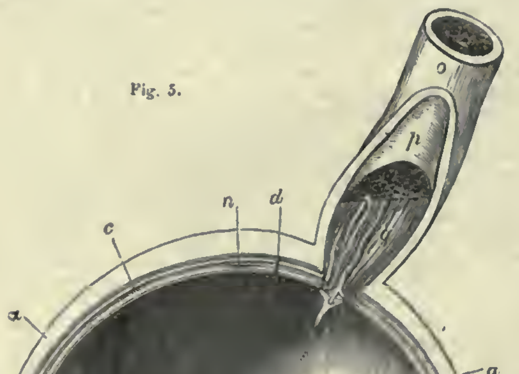
a, sclerotic; *b*, cornea; *c*, anterior surface of lens; *d*, posterior surface of lens; *e*, centre of the eye; *f*, intersection of the axis of direct vision with the back of the eye; *g*, entrance of the optic nerve.

part of the surface of the globe, contains the rest of the aqueous humour, and is bounded in front by the transparent and slightly-prominent disc set in the sclerotic like a watch-glass in its metallic rim, and known as the Cornea, from its horny texture. Its transverse chord, or the diameter of the circle of union between the cornea and sclerotic is nine-twentieths, or nearly half an inch in length.

The globe derives its firmness to the touch from the distension of the contained fluids: its capability to bear that distension, which insures the permanence of its shape, is due to the flexible but strong and inelastic outer covering or tunic, consisting, as we have said, of the sclerotic and cornea.

Sclerotic. (*Fig. 5, a.*)—The Sclerotic Membrane is so called from its toughness (σκληρός, hard, rigid). It may be considered as an expanded prolongation of the sheath of the optic nerve, which it resembles in its interwoven fibrous texture. Its inner surface is continuous with the lamina cribrosa already mentioned. Immediately around this part it is about an eighth of an inch thick, and gradually becomes thinner as it approaches the cornea, which it slightly overlaps. The two structures are not separated by an abrupt line, but are blended together, and adhere so closely that they cannot be torn asunder without great force. The thin glistening tendons of the muscles which move the globe, or rather their smooth outer laminæ are spread over and incorporated with the sclerotic in front, approaching each other till they unite near its junction with the cornea. They render it somewhat thicker in this situation than in the spaces between them or behind the line where they begin to be inserted. This front part of the capsule of the eye is called the tunica albuginea, from the whiteness characteristic of all tendinous parts. When boiled the sclerotic yields gelatine. Under the microscope it is found to consist of true connective tissue, the fibrils of which can be easily demonstrated by teasing or treating transverse sections with acetic acid. Numerous fine elastic elements pervade the connective tissues of the sclerotic, of the same form as in tendons and ligaments, that is, as a net-work. During life the elements of this net-work appear to possess cavities and fluid contents, which according to Virchow form a kind of nutritive system. The vessels are very few in this membrane, and are derived chiefly from the ciliary arteries and those of the muscles of the eyeball. Nerves have been recently described in the sclerotic, but their existence, according to Kölliker, is doubtful.

Fig. 5.



Section of the globe of the right eye through the optic nerve.

a, sclerotic; *b*, cornea; *c*, choroid; *d*, retina; *e*, vitreous humour; *f*, crystalline humour or lens; *g*, aqueous humour; *h*, iris; *i*, ciliary ligament; *k*, ciliary processes; *l*, ora serrata of the ciliary body; *m*, canal of Petit; *n*, foramen of Soemmering; *o*, sheath of the optic nerve; *p*, substance of the nerve; *q*, arteria centralis retinæ.

Conjunctiva.—The albuginea is defended from contact with the air by a transparent mucous membrane, continuous with that which lines the interior of the eyelids. It is called the conjunctiva reflexa, or adnata, to distinguish it from the conjunctiva propria of the lids. It is very loosely connected to the sclerotic at first to facilitate the movement of the globe: as it advances forward it becomes more closely attached to the albuginea; and hence extending to the cornea adheres intimately to its margin and over its whole surface. The conjunctiva is the most sensitive external part of the body to all painful impressions, except cold, especially where it invests the cornea. The smallest particle of foreign matter in contact with it gives intolerable pain, and makes the act of winking to clear it away imperative; and hence its chief and most essential use as part of the delicate organ of which it may be considered as the guardian. If the nerve which supplies it with sensibility be divided or injured, incidental causes of irritation are suffered to produce their injurious effects unheeded, and the eye soon becomes inflamed, ulcerates, and is destroyed.

Cornea. (*Fig. 5, b.*)—The Cornea is somewhat thicker than the sclerotic except at the back of the eye, is equally tough, though rather more flexible, and of a much closer and more even texture. Its inner surface is concave, and nearly parallel to its outer surface; it is however rather thicker in the middle than elsewhere, and the general statement that it has no share in effecting the convergence of incident rays on account of the parallelism of its surfaces is therefore not quite correct. It is covered externally, as we have already mentioned, by the conjunctiva, and is lined internally by a delicate elastic membrane called the Membrane of Descemet or Demours. The bulk of the tunic, or cornea proper, consists of several layers which slide upon each other when the membrane is rubbed between the finger and thumb, and are separated in the natural state by a limpid fluid contained in a delicate cellular structure. This fluid gives plumpness to the outer surface, which is represented by some authorities to be not exactly spherical, but of that kind which would be formed by the revolution of an ellipse of small excentricity about its long axis.

The cornea proper consists of a fibrous substance closely allied to connective tissue, but which, according to Müller, yields when boiled, not gelatine, but chondrin. Its elements, pale bundles 0·002‴—0·004‴ in diameter, in which, at least when teased out, finer fibrils are usually perceptible, sometimes more, sometimes less distinctly, are united into flat bundles. These bundles, which have their flat sides always parallel with the surface of the cornea, decussate in various directions, and exhibit, if not complete lamellæ, yet a distinctly laminated structure, owing to which the cornea is very readily torn and penetrated in the direction of its surfaces, and with great difficulty in that of its thickness.

The conjunctival lining of the cornea is composed principally of a soft laminated epithelium 0·023‴—0·050‴ thick, in which the deeper layers of cells are elongated and placed vertically upon the cornea, whilst the middle ones are more of a rounded form; and as they approach the surface pass into a layer 0·008‴—0·01‴ thick, corresponding to the horny layer of the epidermis, composed of plates 0·01‴—0·14‴ in size, though still nucleated and soft.

The Membrane of Descemet or Demours, as the inferior layer of the cornea is called, consists of an elastic membrane rather laxly attached to the corneal tissue, and of an epithelium on its inner surface. The former is as clear as glass, brilliant, quite structureless, easily lacerable though tolerably firm, and so elastic that when it is raised from the cornea by the scalpel and forceps, by boiling in water, or by maceration in alkalies, under which treatment as under reagents in general it does not lose its transparency, it always rolls up strongly and towards the front. Towards the border of the cornea it passes into a peculiar system of fibres, first described by Bowman. This set of fibres is continued from the cornea on to the iris, where they form the ligamentum iridis pectinatum of Huek, the pillars of the iris of Bowman. The epithelium of the membrane of Demours, which in man frequently does not retain its perfect condition, consists of a single layer of polygonal cells, with extremely fine and pale granular contents and round nuclei. This layer ceases towards the border of the cornea, but isolated indications of its existence may be found along the pillars of the iris.

Although in the embryo of man and the sheep a rich capillary plexus of vessels exists in the conjunctiva, the cornea in the adult human being is nearly non-vascular. It is nevertheless not unfavourably circumstanced for nutrition. Wounds in it rapidly unite; portions of the epithelium, or even of the fibrous layer, are speedily restored when removed; and ulcers are filled up from the bottom with new corneal substance. Fatty deposits in its tissue, particularly in its cellular elements, producing a yellow zone, first accurately described by Mr. Edwin Canton, and called Arcus senilis, or Gerontoxon Nerves, have been described in the cornea by Schlemm; they are derived from the nervi ciliares, and penetrate the sclerotic at its anterior border, and thence enter the fibrous layer of the cornea. They are readily found at the margin of the sclerotic in the form of 24—36 finer and thicker twigs, but scarcely exceeding 0·02‴ in size.

Chorioid or Choroid Membrane. (*Fig. 5, c, fig. 6*).—We have now to consider the internal tunics of the eye, the first of which is the Choroid, or more properly Chorioid Membrane, so called from some resemblance in the flocculence of its outer surface to the chorion, or external investment of the ovum. This is a thin soft dark-brown structure in contact with or lining nearly the whole concave surface of the sclerotic. It may be said to originate around the entrance of the optic nerve, which passes through it before it expands into the retina; and it terminates in the posterior margin of the ciliary ligament, circle, or more properly muscle (*fig.* 5, *i*)—a flattened band of gray matter, about the seventh part of an inch in breadth, attached to the sclerotic internally near its junction with the cornea. In these situations the two membranes adhere with some firmness; they are elsewhere connected by vessels which pierce the outer and ramify upon the inner membrane, and by the filaments of a fine intermediate cellular tissue. But the connection is so slight that it may be readily broken by gentle inflation with a blow-pipe insinuated through a puncture in the sclerotic, without injury to the fragile texture of the choroid. The choroid consists almost entirely of a multitude of minute vessels, curiously interlaced, and communicating freely with each other. It is supplied with blood by 15 or 20 branches of the ophthalmic artery, which pierce the sclerotic round the entrance of the nerve, and are at first distributed externally on the posterior part of the sphere; but they finally pass inwards, and terminate in a close and uniform vascular expansion over the whole concave surface. This is called the tunic of Ruysch, who erroneously considered it as a distinct membrane. The innumerable veins of the choroid, or venæ vorticosæ, are arranged with great elegance and regularity in arched and drooping branches, like the boughs of the weeping willow; they are very conspicuous upon the outer surface, above the first exterior ramifications of the arteries. (*Fig.* 6.) They unite in four or five common trunks, which emerge through the sclerotic at equal intervals behind the middle of the eye-ball. The outer surface of the choroid is somewhat rough and flocculent; the inner surface, upon which the retina is expanded, is delicately smooth and even. Both are abundantly covered with the pigment, which is secreted by every part of the choroid, and pervades its loose and porous texture.

Fig. 6.

The sclerotic partly removed, and the rest turned back, showing the Choroid Coat and Iris. *a*, optic nerve.

The choroid may thus be divided into three layers: 1, an external brown soft lamella supporting the ciliary nerves and long ciliary vessel, and in front containing the ciliary muscle—the outer pigment layer; 2, the less deeply coloured proper vascular layer, with the larger arteries and veins; and 3, a colourless, delicate, internal layer, containing an extremely abundant capillary plexus, the membrana choris-capillaris, which however does not extend farther in front than the ora serrata. The tissue of which the choroid is composed, independent of its vessels and nerves and the ciliary muscle, is intermediate between elastic and connective tissue. Bowman was the first to demonstrate the true muscular structure of the ciliary ligament or muscle as it is now more properly called.

Pigment.—In man this matter is of a deep-brown colour, in most other animals it is black, and hence is very commonly called the Pigmentum Nigrum. It appears under the microscope to consist of almost regularly hexahedral contiguous cells, 0·006‴—0·008‴ in diameter, 0·004‴ thick, disposed in an elegant mosaic manner, in which the large quantity of brownish-black pigment usually prevents the nucleus being apparent as more than a clear spot in the interior. It adheres very loosely, so that when the surfaces covered with it are drawn to and fro in water, it becomes diffused, and may be washed off. The choroid thus treated is found to be of the same whitish or gray colour which characterises the ciliary ligament. In the natural state of the parts, not only the choroid, but the cellular tissue on its external surface, and the inside of the sclerotic, are deeply stained by the pigment, which shows through, and occasions the bluish tint of the white of the eye in persons of delicate complexion. But on the inner surface of the choroid the pigment is retained by an expansion finer than a spider's web, yet of close texture, which may be called after its discoverer the membrane of Dalrymple. By this means the transparency of the retina is preserved. It is probable that this membrane of the pigment is of a serous kind, and that it is reflected at the optic and ciliary margins of the choroid, and passes over the whole posterior surface of the retina—thus doubly defended from absolute contact with the pigment. The choroid is not the only part which secretes this colouring matter. It is found in equal or greater abundance upon the back of the iris, on the surfaces of the ciliary processes, and in fact wherever it is wanted to facilitate vision. The pigment cells are absent in the eyes of albinos, as well as, at any rate partially, in the region of the tapetum in animals.

In many animals, especially the nocturnal and carnivorous tribes, the pigment is deficient at the bottom of the eye, and the surface of the choroid in that situation presents a brilliant colour and almost metallic lustre. This is called the Tapetum (tapestry of divers colours). It is of various shades of blue, green, and yellow; sometimes changeable like shot silk, and sometimes of a silvery whiteness. The tint occupies various proportions of the surface; it is most brilliant immediately opposite the pupil, and passes gradually into the dark hue of the pigment. There is no vestige of a tapetum in the human eye. The use of it is not well known. It probably causes the animal to see better in the dusk and less clearly in the day, by reflecting the rays a second time through the retina. This reflection from a very effective concave mirror produces a strong convergence of the rays which come back through the pupil, and is the cause of the well-known glare of the eyes of cats and other animals seen in an obscure light from that particular distance at which the emerging rays are most completely brought to a focus upon the eye of the observer. The breadth of this luminous appearance arises from the great dilatation of the pupil under the circumstances in which it is seen.

Retina.—The optic nerve, having entered the interior of the globe through the sclerotic and choroid membranes, forms a slight prominence at the point of union of its several portions, and thence spreads out in the form of a fine transparent membrane over the whole concave surface of the choroid, embracing the translucent body called the Vitreous Humour. Towards the choroid it appears to consist of a mere homogeneous pulp, not very different from the medullary matter of the brain; but it is undoubtedly most elaborately and minutely organised. Towards the vitreous humour it has the structure of a most delicate vascular web, consisting of innumerable ramifications of the central artery (which, as we have already mentioned, accompanies it into the interior of the globe) and of its associated veins. Its name may have been derived from the net-work formed by the visible branches of these vessels; at least it is not otherwise applicable to the structure of the membrane. The distribution of the central artery may be made visible to an observer in his own eye by a curious experiment first suggested by Purkinjé. One eye being steadily directed to a surface of some uniform dark or neutral tint, such as a wall painted of a lead colour, and the other eye closed by the hand, the flame of a small wax-taper is to be slowly waved round and round, so as to be brought at every turn at a little distance over the front of the eye. The central artery will gradually come into view, at first obscurely, and afterwards more clearly. The experiment succeeds best after the experience of several trials on successive nights. The form is such as might be expected from a branching net-work of vessels: the lines are dark, with bright edges on a faintly illuminated ground. There are other modes of making the experiment, which show the appearance more distinctly, but they are less simple. The retina terminates anteriorly in a thin scalloped edge, fitting into corresponding irregularities called the ora serrata in the posterior margin of the ciliary body. (*Figs.* 5, *l*; 9, *d*.) Exactly opposite the pupil there is a bright yellow spot, fading gradually off at the edges, and having a black point in the centre precisely where the axis of direct vision intersects the back of the eye. (*Fig.* 5, *n*.) This central point was believed by its discoverer, Soemmering, to be an actual deficiency of the substance of the retina; and it is generally called in consequence the foramen of Soemmering. But it is now known to be merely a central absence of the yellow colour of that part of the retina rendered conspicuous by the pigment seen through the ordinary transparent texture. These appearances are lost very shortly after death, and are replaced by a minute fold, into which the retina gathers itself, reaching from the place of the central point to the prominence which marks the union of the divided portions of the nerve. The use of this yellow spot and central point, and of the tendency of the retina to assume a folded shape in this situation is not understood.

The microscopic construction of the retina has been recently studied by Pacini, Kölliker, and Müller. Although of variable thickness in all parts it may be divided into the five following layers:—

1. The layer of rods and cones called the bacillar layer.
2. The granular layer.
3. The layer of gray nerve-substance.
4. The expansion of the optic nerve.
5. The limitary membrane.

"The bacillar layer, stratum bacillorum, seu membrana Jacobi, presents a very remarkable structure, being composed of innumerable rod-like and conical corpuscles, disposed with the utmost regularity, and reflecting the light very strongly. With the exception of H. Müller, this structure in animals has been understood quite erroneously, and even in man it has been but very superficially known. It consists of two elements, the rods (bacilli) and the cones (coni), which together constitute a single layer 0·036‴ thick at the bottom of the eye, more anteriorly 0·024‴, and quite in front not more than 0·015‴ in thickness. In general these bodies are so arranged that the more numerous rods have their largest ends directed outwards, whilst the cones are disposed in the reverse direction, whence the latter when imperfectly examined appear to constitute an inner, distinct, thinner layer, lying between the inner extremities of the 'rods.'" (Kölliker.)

The granular layer is composed of opaque granular corpuscles, reflecting the light tolerably strongly, of a round or oval figure, and 0·002‴—0·004‴ in size, sometimes looking like free nuclei, sometimes like minute cells almost entirely filled by large nuclei.

The layer of cineritious cerebral substance is pretty sharply defined on the side of the granular layer, and less so towards that of the fibres of the optic nerve, between the elements of which it penetrates more or less. It is composed of a finely granular matrix, corresponding exactly with that of the gray substance on the surface of the cerebrum and cerebellum, and of numerous nerve-cells scattered in it.

The expansion of the optic nerve. This nerve after quitting the brain and till it reaches the eye presents the same conditions as in the ordinary nerves. Within the canal of the sclerotic and as far as the colliculus nervi optici, the optic nerve retains its white colour, and presents dark-bordered tubules, but from that point onwards its elements become perfectly clear, yellowish or grayish, and transparent, like the finest tubules in the central organs, measuring on the average not more than 0·0006‴—0·0008‴; some it is true are occasionally larger. What chiefly distinguishes these from other pale nerve-terminations, is the absence of nuclei in their course, a somewhat greater refractive power, and the frequent occurrence of varicosities, which two latter particulars would seem to indicate, if not exactly a nerve-medulla, as in the common nerves, still the existence of partially semi-fluid and perhaps fatty contents, and assimilate the nerve-fibres of the retina to the most delicate elements of the cerebrum. The nerve-fibres radiate on all sides from the colliculus nervi optici, and constitute a continuous membranous expansion, which extends as far as the ora serrata retinæ, and presents very considerable interruption only in the situation of the macula lutea.

The limitary membrane is a delicate membrane, 0·0005‴ thick, intimately united with the rest of the retina, which when that structure is teased out, and on the application, is frequently detached in large threads, and then appears perfectly structureless. On its inner aspect towards the hyaloid membrane, when the retina is folded, flattened cell-nuclei are occasionally perceptible, which certainly cannot be referred to an epithelium, and Kölliker thinks not to the vitreous lens either, as the latter is always separable from the retina.

The nature of the rods and cones in the bacillar layer have been much discussed. It has been supposed that they are the terminations of the optic fibres. There are however difficulties in the way of this theory; "among which," says Kölliker, "not the least is the circumstance that although the 'rods' and 'cones' are certainly fifty times more numerous than the fibres of the optic nerve, yet the radiating fibres arising from the former, on their passage into the optic fibres, subdivide, and as it must probably be assumed, are continuous with several of them." "I look upon the 'rods' and 'cones,'" he continues, "which may also be said to correspond in all chemical characters with the nerve-fibres of the retina, and the whole of the radiating fibre-system of the retina, as true nervous elements; and venture at the same time to broach the bold supposition, founded upon a less established basis, that the 'rods' and 'cones' are the true percipients of light, and that they communicate their condition to the fibres of the optic nerve, by means of the direct or indirect connection of their fibrous processes with the former, through which again the impressions are conveyed to the sensorium." He thinks that the optic fibres in the nervous expansion of the retina do not perceive light, for the following reasons:—1. That the point of the retina, where those fibres alone are found, is not sensible to light. 2. The optic fibres are superimposed upon each other in such numbers that it is impossible they should perceive light, inasmuch as each luminous impression, owing to the transparency of the fibres, must in any case always affect many of them, and consequently would of necessity give rise to confused sensations. 3. Because this part of the retina in which there is no continuous layer of nerve-fibres on the inner surface, that is to say the 'yellow spot,' is the most sensitive to luminous impressions. Under this notion the import of the 'rods' and their remarkable arrangement would be intelligible, and the almost inexplicable correspondence in the size of the images of the smallest distinguishable interspaces between two objects, with the diameter of the 'rods' and 'cones,' be placed in its true light.

Vitreous Humour. (*Figs.* 5, *e*; 7 *d*.)—The part next in order to be described is the vitreous humour, behind which the retina is disposed. It is a transparent fluid of semigelatinous consistence and high refractive power, constituting about five-sixths of the bulk of the globe. It consists of a fluid differing in no great degree from water, contained in a cellulated structure called the hyaloid membrane (ὕαλος, glass), from its perfect translucency. The minute cells are connected together; for if the external part be punctured, the fluid contained in them gradually drains away. This cellular structure is so delicate and fragile that it is almost impossible to obtain it separately; but the membranous partitions are rendered slightly opaline by strong spirit or diluted acids, and may thus be made evident. It is condensed into a membrane of a firmer consistence upon the surface, which serves the general purpose of a containing capsule for the vitreous humour, and is strong enough to cause it to preserve its shape in some degree when the stronger tunics of the eye are removed. There is a narrow tubular dimple of some depth in the vitreous humour opposite the entrance of the nerve, lined by a trumpet-shaped production into it of the external membrane, called the hyaloid canal. (*Fig.* 5.) It serves to transmit a branch of the retinal artery and associated veins for the nourishment of the capsule of the lens in the fœtus, and perhaps also of the hyaloid membrane, and of the substance of the lens itself. There can be no doubt that the vitreous humour is secreted by the surfaces of the hyaloid cells, but this fœtal artery is the only vestige of a vascular arrangement yet discovered in the part.

Fig. 7.

This figure, from the work of Zinn, represents the Vitreous Humour in its hyaloid membrane. The lens, imbedded in its upper surface, is surrounded by the canal of Petit. The dark border beyond is the plaited portion of the hyaloid membrane called the zone of Zinn, stained with the pigment left by the ciliary body, which in the natural state of the parts rests upon that portion of the surface of the hyaloid. The outer edge of the zone is marked by a waved outline, corresponding with the ora serrata of the ciliary body.

a, crystalline lens; *b*, canal of Petit; *c*, zone of Zinn; *d*, vitreous humour.

The zone of Zinn, or zonula Zinnii, is that portion of the hyaloid membrane which is continued to the border of the lens, where it becomes blended with the capsule of that body. In doing this it splits into two lamellæ, the posterior of which is blended with the capsule of the lens, and the anterior connected with the ciliary processes which are attached to the capsule of the lens a little in front of its margin. Between the two lamellæ and the border of the lens there is left a space surrounding the latter in an annular manner, and in a transverse section of a triangular form. This is the canal of Petit. The darker colour of the zone of Zinn appears to depend on the existence of pigment-cells belonging to the choroid, which are situated principally in the folds in which the processus ciliares were contained, and give the whole zone a striped aspect. On the inner side of this layer lies a single layer of clear very frequently pale polygonal nucleated cells of 0·006‴—0·012‴ in size, but which is never entire, being always partially removed together with the ciliary processes on which Henle and others have noticed it.

Lens, or Crystalline Humour. (*Figs.* 5, *f*; 7, *a*; 8.)—The crystalline lens (κρύσταλλος, crystal) is imbedded in a deep depression in the front of the vitreous humour, a little nearer the nasal than the temporal side of the globe. It has the form and function of a double convex lens. The surfaces may be considered as portions of two unequal spheres, the anterior being considerably flatter than the posterior. The diameter of the sphere of which the former is a segment is about eight-twelfths, of the latter five-twelfths of an inch. The thickness of the lens, measured in the axis of vision, is about the sixth part of an inch, and its transverse diameter is about twice that length. (*Fig.* 4, *c c*, *d d*.) In refractive power it is superior to the other transparent substances contained in the eye. Its consistence is gelatinous, increasing in density from the circumference towards a central nucleus, which has the tenacity of soft wax. It is composed of an infinite succession of thin concentric laminæ, arranged with the utmost regularity one within another like the coats of an onion; and every such stratum or elliptic shell is made up of a series of exquisitely minute fibres laid side by side, forming three septa like the cloves of an orange, of which the bounding or cleavage planes diverge from the axis of the lens at angles of 120° in the manner represented in the annexed figure. (*Fig.* 8.) If the lens be hardened in strong spirit, the result of this curious arrangement is, that it partly cleaves into three portions made up of layers which may be peeled off one after another, each further separable to a certain extent into its component parallel fibres. The spirit not only hardens the crystalline humour, but renders it opaque; and the same effect is produced by plunging it in boiling water, as every one must have observed in the eyes of dressed fish. In fact it consists chiefly of the transparent substance called albumen found in eggs, and is coagulated by heat in the same way. The lens is similarly constructed in the eyes of other *Mammalia*; and analogous, though not identical, arrangements are observed in other classes. In fish the fibres we have spoken of are curiously hooked together by fine teeth, resembling those of a saw. We chiefly owe the discovery of these facts respecting the intimate structure of the lens to the labours of Leeuwenhoek, Young, and Brewster, whose writings may be consulted for much further interesting information on the subject. The crystalline lens is inclosed in a transparent and highly elastic membranous capsule, represented in *fig.* 5 by a white line, to the regulated pressure of which the preservation of its true shape, so important to the purposes of vision, is mainly attributable. There is no analogous structure in the body, except the internal lining of the cornea already mentioned, which closely resembles it in its function with reference to the surface of the aqueous humour. When the lens is hardened in spirit or boiling water, this capsule retains its nature; and if peeled off, shrivels up and curls upon itself. It may be easily detached with a piu from the hard spherical lens of a boiled fish, and will be found still possessed of its peculiar qualities of transparency and elasticity. The capsule is firmly attached to the hyaloid membrane behind, from which it is not easy to separate it neatly. Whether it has any further conuection than that of mere contact with its own contents, is not easy to show, or to doubt; but the nature of that connection, if any exists, might be expected to be obscure, considering that both the parts are diaphanous, and one of them almost liquid at the surface of contact. Indeed it has been supposed that a small quantity of limpid fluid was actually interposed between the lens and its capsule, but this is now shown to be the result of imbibition after death.

Fig. 8.

Magnified view of the Crystalline Lens, showing its laminated and fibrous structure, and the direction of its planes of cleavage.

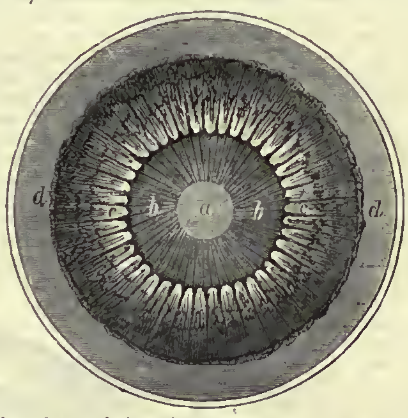
The capsule of the lens when examined under the microscope is found to consist of two elements, the proper capsule and epithelium. The former is a perfectly structureless and transparent highly elastic membrane, inclosiug the lens on all sides as if moulded to it, and parting it from the neighbouring structures. The epithelium is placed on the inner surface of the capsule towards the lens, liniug the anterior half of the capsule, with a single layer of beautifully clear polygonal cells, of 0·006‴—0·01‴, with round nuclei. The lens itself consists entirely of elongated flat hexahedral elements, 0·0025‴—0·005‴ broad and 0·009‴—0·0014‴ thick, of a perfectly transparent aspect, very flexible and soft, and having a considerable degree of toughness, which have usually been described as the fibres of the lens, although they are nothing more than thin-walled tubes with clear viscous albuminous contents, which when the tubes are torn escape from them in the form of large irregular drops, aud consequently might suitably be described as the tubes of the lens. These bodies become opaque by the application of all agents that coagulate albumen, as uitric acid, alcohol, heat, chromic acid, and creosote. In caustic alkalies and acetic acid they are quickly dissolved. The coucentric laminæ, which consist of these tubes, are not regularly defined layers, aud never consist of a single stratum of tubes. The course of the tubes in the separate lamellæ is in general such that both the superficial and the deeper in the centre of the lens radiate towards the margins, and then curve round upon the other surface anterior or posterior, but in such a way that no fibre extends through the entire semicircumference of tho leus, or reaches, for instance, from the middlo of the anterior surface to that of the posterior. More precisely described, the tubes on the anterior and posterior surfaces of the lens do not proceed exactly to the middle, but terminate in a stelliform fissure (*fig.* 8) which exists in that situation.

Aqueous Humour.—This fluid, in no respect distinguishable from water except in holding a minute proportion of several saline ingredients in solution, occupies the space between the lens and the cornea. The iris divides this space into two unequal portions called the anterior and posterior chambers of the eye, and so closely approaches the lens that near the margin of the pupil the two surfaces are separated by a mere film of aqueous humour. The cavity is lined throughout by a serous membrane, which secretes and limits the fluid, aud prevents it from acting injuriously upon subjacent parts of importance. At least a membrane of this kind may be peeled off in some animals; its existence in the hnman eye is rather a matter of infercuce than proof.

Iris. (*Figs.* 5, *h*; 9, *b*.)—In speaking of the choroid we have already adverted to the flattened ring called the ciliary ligament or muscle (*fig.* 5, *i*), which connects it in front with the sclerotic. The iris arises from the auterior margin of this ring, and is extended, as we have seen, across the aqueous humour in the form of a thiu partition with a round aperture, or pupil, of variable size in the centre, or a little nearer the inner side, the function of which, we need hardly repeat, is to regulate the quantity of light admitted into the eye, by contracting when it is in excess, and dilating when it falls short of the due amount.

The external appearance of the iris is too familiar to need a particular description. It is covered iu front with a glistening polished membrane. The brilliancy of the eye depeuds in a great measure upon the light reflected by this surface, and is lost when its smoothness and transparency are impaired by inflammation. The posterior surface of the iris is called the uvea. (*Fig.* 9, *b*.) It is thickly coated with pigment, which is prevented from diffusing itself in the aqueous humour by a membrane liko that on the choroid. Such a provision is particularly needed here ou account of the quick movements of the part in a watery fluid. The colouring matter of the iris has much analogy with the pigment. Like that substance it forms no part of the texture it pervades; and when the outer membranes are removed by maceration iu water it may be washed away. Both have a relation in quantity as well as in depth of tint to the complexion and colour of the hair. In the negro tho iris is of so dark a hue that it can scarcely be distinguished from the pupil; while in the white rabbit and other albinoes, including the human variety, where the pigment is entirely wanting from some origiual malformation, the substance of the iris is transparent, and reflects only the pink colour of the circulating blood. Such eyes are dazzled by a strong light, and probably see better than others in tho dusk. The iris, if minutely injected, appears, like the choroid, to be composed almost entirely of vessels. It is principally supplied by the two long ciliary arteries (*fig.* 6) which pierce the sclerotic about half an inch from the optic uerve on either side; and passing between that membrane and the choroid divide near the edge and in the substance of the ciliary muscle, and are wholly distributed to the iris. Their branches are disposed in two conspicuous circles on the front surface, one near the outer or ciliary margiu, the other uot far from the pupil. But though the iris resembles the choroid in vascularity, it differs essentially from it in other respects. It is richly supplied with nerves, which proceed to the iris and are distributed upon it much in the same way as the arteries, and are the medium of its sympathy with the retina, and the source of its irritability. It also possesses a peculiar contractile power, which is dependent on smooth muscular fibres of precisely the same kind as those found in the ciliary muscle of the choroid. These fibres are disposed circularly in front and at the fore edge, and in a radiated form behind. (*Fig.* 9, *b*.) (See Lister on the Contractile Tissue of the Iris, 'Quarterly Microscopical Journal,' vol. i.)

Fig. 9.



Magnified view of a vertical section of the globe, showing the ciliary body and processes with the uvea, as seen from behind when the lens is removed.

a, pupil; *b*, uvea, or back part of the iris; *c*, processes of the ciliary body; *d*, ora serrata of the ciliary body, to which a few shreds of the vascular web of the retina remain attached.

Pupil. (*Fig.* 9, *a*.)—The pupil iu the human eye is bounded by a sharp well-defined circular edge. In other animals its shape is subject to mauy varieties which may often be explained by a reference to their habits and circumstances. In fish it is generally crescentic or imperfectly quadrangular. In herbivorous animals, which often continue to browse during the night, it is oblong and obliquely transverse, as in the horse and sheep. In most serpents and many rapacious quadrupeds, both aquatic and terrestrial, the pupil though large and round at night is a mere vertical slit when seen by day, especially in the smaller species of each geuus, as in the common cat. It is curious that in the larger cats, as the lion and tiger, as well as in some of the larger four-footed reptiles, tho pupil again becomes circular. In all birds, we believe, the pupil is round; and it may be observed that, with few exceptions, they all sleep after night-fall. In the few nocturnal species, as the owls, the pupil is very large though still round, and these birds always shun the day. The long uarrow pupil is in fact a provision for a greater variation in sizo than tho circular form permits, and is generally found in those animals which roam at night and also see well by day. Wheu abseut in such animals the bulk of the organ is commouly sufficient to secure the admission of a sufficient quantity of light after sunset without this provision. In the fœtus the pupil is closed by a vascular film called the membrana pupillaris, one function of which is precisely that of the centering of a bridge to support and extend it during the process of its construction. A tubular film of the same kind has been lately discovered by Müller stretched between the margin of tho pupil and the ciliary body. Both these films are absorbed before birth.

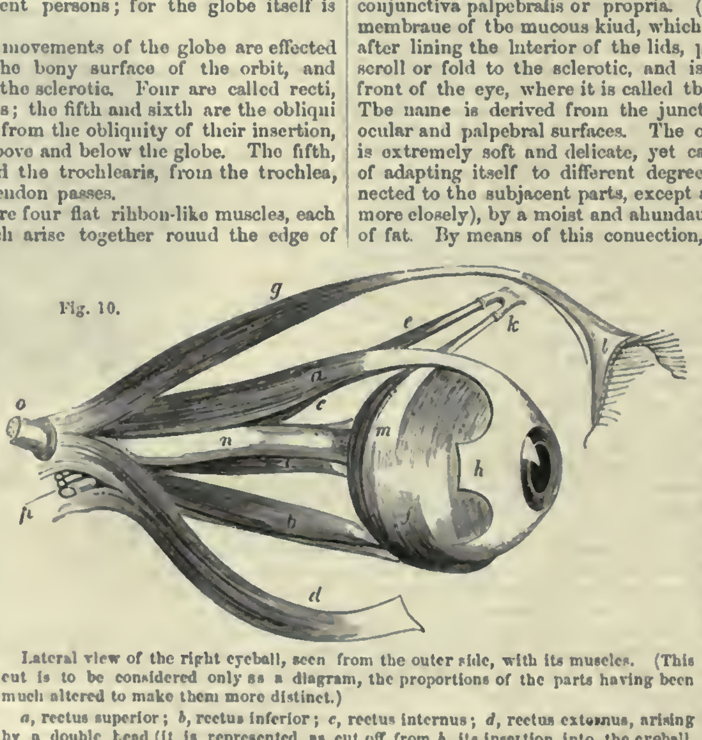
Ciliary Body and Processes. (*Figs.* 5, *l*; 9, *d*, *c*.)—Upon the compressed anterior surface of the vitreous humour where it curves inwards from the sclerotic towards the lens, rests the ciliary body, a thin, dark, annular band, about the fifth part of an inch in breadth, consisting of a frill of flat converging plaits, which encircle but do not reach the circumference of the lens. The posterior aspect is concave, and adheres loosely over the rounded vitreous humour; the front is convex, and is firmly attached to the whole breadth of the ciliary ligament, and to a small portion of the back of the iris near its junction with the ligament. It appears to be a continuation of the inner layer of the choroid, or tunic of Ruysch, but is rather thicker, and resembles it in extreme vascularity. The medullary matter of the retina terminates, as we have seen, at the indented posterior margin (ora serrata) of this membranous band. The ciliary body is everywhere thickly coated and pervaded with pigment, except at the extremities of about seventy minute unattached points which fringe the inner margin, and radiate towards the lens like the florets of a marigold round its central disc. These are the ciliary processes. (*Figs.* 5, *k*; 9, *c*.) They are separated from the uvea by the fluid of the posterior chamber, and are received behind into corresponding depressions in the vitreous humour.

Appendages of the Globe.—The Eyeball, of which we have thus described the contents, is lodged in the cavity of the orbit, a little nearer the inner than the outer side. In front, where the protection of bone is wanting, the two moveable and muscular eyelids supply a sufficient defence, and contribute, by their gentle and constant pressure, to keep the eye in that state of equilibrium between opposite forces upon which the steadiness and precision of its rapid motions in a great measure depend. The space in the socket not occupied by the globe and its appendages is completely filled by a cushion of soft fat, contained in elastic membranous cells, which permits the free movement of the several parts, while it keeps them separate, and affords them all, as well as the globe itself, a suitable and uniform support. Varieties in the quantity of this substance, in the capacity of the orbit, and in the development of the lids, determine the different degrees of prominence and of apparent size observed in the eyes of different persons; for the globe itself is nearly of the same size in all.

Muscles of the Eyeball.—The movements of the globe are effected by six muscles arising from the bony surface of the orbit, and inserted into different parts of the sclerotic. Four are called recti, that is straight or direct muscles; the fifth and sixth are the obliqui superior and inferior, so called from the obliquity of their insertion, and their respective positions above and below the globe. The fifth, or superior oblique, is also called the trochlearis, from the trochlea, or pulley, through which the tendon passes.

The recti (*fig.* 10, *a*, *b*, *c*, *d*,) are four flat ribbon-like muscles, each about half an inch broad, which arise together round the edge of the foramen opticum, and embrace the nerve at its exit from the skull. They end in broad thin glistening tendons, attached to the sclerotic at four equidistant points, about a quarter of an inch from the edge of the cornea, above, below, and on either side. Hence they are designated as the superior, inferior, internal, and external straight muscles. We have already explained how the outer surfaces of their tendons are blended, and form the tunica albuginea. Each turns the pupil towards the side of its insertion; and it is easy to see how by their single actions, or by a proper combination of two that are contiguous, the pupil may be turned in any required direction. The rectus externus, from its position on the diverging side of the orbit, is necessarily the longest of these muscles. It has also a double origin, arising not only in common with the rest from the edge of the optic foramen, but also from the edge of the sphenoid fissure, and arches over several nerves which enter the orbit by that passage (*p*). The superior oblique or tochlearis (*e*) is a round tapering muscle, which arises near and on the nasal side of the rectus internus (*c*), and ends in a smooth round tendon. The pulley (*k*) through which this tendon passes is a small loop of cartilage fixed to the roof of the orbit towards the nasal side, just within the margin. In this situation the tendon is enveloped in a lubricated extensible sheath called bursa mucosa; thence spreading into a thin fan-like expansion, it is reflected obliquely backwards and outwards between the globe and the tendon of the rectus superior (*a*), and is inserted into the back part of the sclerotic at a point (*m*) intermediate between the optic nerve and the insertion (*h*) of the rectus externus, and nearer the former. Its separate action turns the pupil downwards and outwards. The inferior oblique (*f*) arises broad within the lower edge of the orbit towards the nasal or inner side, and passing obliquely backwards over the tendon of the rectus inferior (*b*), is attached to the sclerotic at the outer and back part opposite the insertion of the trochlearis. It directs the pupil upwards and outwards, supposing the eye to look originally straight forwards: if the pupil be inclined either way, to the nose or to the temple, the inferior oblique increases that inclination, being equipoised as to lateral action when the eye is slightly turned inwards, as in reading. But its tendency is always to turn the pupil upwards. To a certain extent the same remark is applicable (mutatis mutandis) to the action of the antagonist muscle, the superior oblique, which if exerted at the same time would counteract the tendency upwards, so that both taken together would keep the eye in that easy position so often assumed by man and animals in looking without much effort yet steadily at near objects, as in taking food, reading, and most other quiet occupations. The position we mean is that in which the axes of vision are directed slightly towards each other and a little downwards, and the eyeballs are gently pressed against the lids and by them, and thus are kept in a convenient and steady equilibrium. When the oblique muscles act together with force, they hold the eyeball firmly against the lids and to the nasal side of the orbit. One or both of these muscles, as well as the rectus externus, are supposed to be endowed with certain automatic or involuntary actions, very useful in the economy of vision. Their functions in this and other respects have given occasion to much curious disquisition.

Fig. 10.



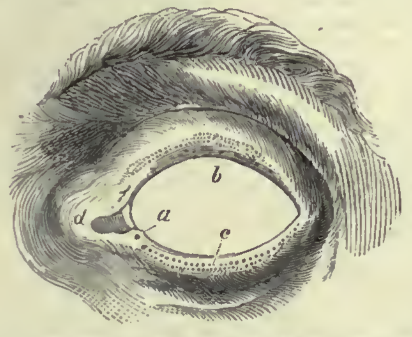
Lateral view of the right eyeball, seen from the outer side, with its muscles. (This cut is to be considered only as a diagram, the proportions of the parts having been much altered to make them more distinct.)

a, rectus superior; *b*, rectus inferior; *c*, rectus internus; *d*, rectus externus, arising by a double head (it is represented as cut off from *h*, its insertion into the eyeball, and turned aside to show the parts behind it); *e*, obliquus superior, a round and tapering muscle terminating in a round tendon, which passes through a pulley or loop (*k*), and is reflected under the flat tendon of the rectus superior, and, becoming flat, is inserted at (*m*) into the sclerotic; *f*, obliquus inferior coming round over the tendon of the rectus inferior from the front and inner edge of the orbit, near the inner corner of the eye, and inserted into the sclerotic opposite the insertion of the superior oblique; *g*, levator palpebræ superioris, ending in a flat tendon, which is inserted into (*l*) the crescentic tarsal cartilage of the upper lid; *o*, *n*, the optic nerve; *p*, the nerves of the 3rd, 5th, and 6th pair, which pass between the two heads of the rectus externus. The rest of their course is not shown.

The Eyelids or Palpebræ. (*Figs.* 11, 12, 13.)—The textures which enter into the composition of the eyelids are included between a soft external skin and a moist smooth internal surface, called the conjunctiva palpebralis or propria. (*Fig.* 13, *a a*.) The latter is a membrane of the mucous kind, which, as we have already mentioned, after lining the interior of the lids, passes across in a loose circular scroll or fold to the sclerotic, and is reflected back again over the front of the eye, where it is called the adnata or conjunctiva reflexa. The name is derived from the junction thus effected between the ocular and palpebral surfaces. The outer skin of the eyelids, which is extremely soft and delicate, yet capable to a considerable extent of adapting itself to different degrees of extension, is loosely connected to the subjacent parts, except at the margin (where it adheres more closely), by a moist and abundant cellular tissue, entirely devoid of fat. By means of this connection, when the upper lid is raised and these under-lying parts are retracted under the edge of the orbit, the superfluous skin is gently drawn after them, and is disposed of conveniently under the brow (supercilium). The eyelids meet, when closed, by two narrow flat surfaces, accurately applied to each other, called their ciliary or tarsal margins. These epithets are respectively derived from the tarsi, or thin concave and crescentic shells of smooth and elastic cartilage which give form to the lids, and firmness and outline to their opposed edges (*fig.* 10, *l*); and from the lashes or cilia, which grow in several rows at the margins of both lids, from their extreme outward verge, and in the direction of the flat surfaces. The angles in which the margins of the eyelids meet towards the nose and temple are called the canthi. The outer canthus is kept in its place during the motions of the part by a tendinous expansion or aponeurosis, which, adhering to the thin crescentic edges of both tarsi on their outer or convex surface, attaches them, and most closely on this (the temporal) side, to the margin of the orbit. It is called the broad ligament of the tarsi. The nasal extremities of the tarsi are confined to the side of the nose by two slips which are given off behind from the tendon of the orbicular muscle.

Muscles of the Eyelids.—Immediately beneath the subcutaneous cellular tissue there is a broad layer of muscular fibres arranged elliptically round the transverse fissure of the eyelids, the disposition of which is well shown in *fig.* 12. The office of this muscle, which is called the orbicularis, is to close the lids; and it is capable of acting under certain circumstances with great force. It is collected at the inner angle or canthus of the eye into a round short tendon, which is attached in that situation to the bone. Elsewhere it is connected with the skin and aponeurotic expansions of the face and forehead. It is also connected with the occipito-frontalis muscle, which elevates the eye-brows and with the corrugator supercilii, which wrinkles and knits them in the act of frowning. A

Fig. 11.



View of the left eyebrow and lids, showing their tarsal margins.

a, lower punctum lachrymale; *b*, tarsal edge of the upper lid; *c*, orifices of the ducts of the Meibomian glands (those on the upper lid are similar); *d*, caruncle, situated at the inner canthus, or corner of the eye.

The double line of points external to the Meibomian orifices marks the situation of the eyelashes, which are removed.

Fig. 12.

View of the orbicular muscle of the left eyelid, as it appears when denuded of the integuments.

a, the tendon at the inner angle, or canthus of the eye; *b*, the outer canthus drawn in by the ligamentous attachment of the tarsal cartilage to the temporal side of the orbit.

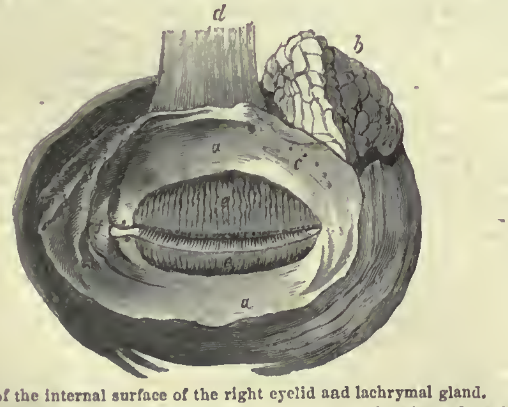


Fig. 13.

View of the internal surface of the right eyelid and lachrymal gland.

a, conjunctiva propria, or mucous lining of the lid. The edges of the fold which passes to the sclerotic are seen loose and floating; *b*, lachrymal gland; *c*, orifices of the lachrymal ducts; *d*, tendon of the elevator muscle of the upper lid; *e e*, parallel rows or clusters of the Meibomian glands; *f*, the semilunar fold of the conjunctiva at the inner canthus, which is the rudiment of the third eyelid of birds and other animals. Near *f*, on the right, are seen the two puncta lachrymalia.

person acquainted with mechanics will have no difficulty in perceiving the advantage derived from the oblique, or, as it might almost be called, the incidental action of the orbicularis in closing the lids, to the edges of which its fibres are parallel. A more direct application of muscular force would have been more powerful; but the actual arrangement secures a rapidity incomparably more conducive to the function of the eyelids, which is to cleanse and moisten the surface of the eye.

Levator Palpebræ Superioris.—Below the orbicularis, in the upper lid, is the broad tendon of the muscle which elevates the upper lid. (*Figs.* 13, *d*; 10, *g*.) This muscle arises from the edge of the optic foramen, just above the rectus superior, and passing over it along the roof of the orbit, forms the thin tendon we have mentioned, which is inserted into the inner surface or rather the thin upper edge of the tarsal cartilage. There is no such provision for depressing the lower lid, which is rendered unnecessary by its inferior extent. Moreover the muscle we have just described sufficiently answers the purpose, by pressing down the globe, and causing it to slide a little forwards; as may be easily felt if a finger be placed against the lower lid when the eye is close, and suffered to remain while the upper lid is slowly raised.

Meibomian Glands. (*Fig.* 13, *e, e*).—Between the tarsus of either lid and the conjunctiva are disposed numerous vertical rows of minute whitish grains, which appear through the semi-transparent mucous membrane, and occupy an elliptic space, taking both lids together, of about half an inch in width, exactly in front of the globe. These are called the Meibomian glands, from their discoverer. They secrete an unctuous matter which passes into tubes centrally placed in each row, and exudes from as many minute orifices on the ciliary margin of the lid. (*Fig.* 11, *c*). There are about forty of these parallel clusters in the upper lid: in the lower there are not so many, nor are they individually so long. We need not dilate upon the use of this secretion, which often collects in a sensible quantity upon the edges of the lids during sleep, especially when the glandular action is excited by slight inflammatory irritation of the part. The palpebral conjunctiva, already described, immediately covers these glandular corpuscles. The caruncle, a small red prominence at the inner angle of the eye (*fig.* 11, *d*) consists of a number of similar bodies.

Lachrymal Apparatus. (*Figs.* 13, 14).—At the upper and outer part of the interior of the eyelid are several minute orifices (*fig.* 13, *c*), generally seven in number, arranged in a half circle, which lead into the secretory ducts of the lachrymal gland. (*Figs.* 13, *b*; 14, *e*.) This is a white flattened lobulated body, of the size of a large bean, lodged in a depression just within the margin of the orbit, and covered externally by the orbicular muscle. The function of this gland is to secrete the tears; and is probably always going on, although not in a degree sufficient to be remarked, except in weeping, or when some foreign body or acrid vapour stimulates the surface of the eye, and by sympathy excites the gland to unusual secretion.

Fig. 14.

a, the two puncta leading into the lachrymal ducts; *b*, the common entrance of these ducts into the lachrymal sac; *c*, the head of the lachrymal sac; *d*, the narrow portion of the sac, or membranous lachrymal canal passing downwards to the nose; *e*, the lachrymal gland.

The involuntary actions of the rectus externus and inferior oblique muscles, to which we have alluded, are supposed to have a relation to the lachrymal secretion. In the act of winking, the eye-ball is thrown up in an outward direction, as it would be by the action of these muscles, which not only brings the cornea into the vicinity of the ducts, but makes pressure upon the gland, while it relatively increases the rapidity with which the lids, drawn in winking towards the fixed nasal tendon are swept over the surface of the globe. That there is such a movement however produced is certain: the motion of the prominent cornea may be felt by the finger gently pressed upon the half-shut lid if it be completely and suddenly closed. The approximation of the lids towards the nose in winking is one of several provisions by which offending particles or superfluous fluids are brought to the inner canthus of the eye to be protruded or absorbed. In this situation there is a vacant space partly occupied by the caruncle, called the lacus lachrymalis (*fig.* 11, *d*); it is a sort of reservoir or rather sink for the tears. Above and below, at the entrance to this space where the ciliary margins terminate, there is a small prominence on the inner edge of both (*figs.* 11, *a*; 14, *a*), centrally punctured by small orifices. These are the puncta lachrymalia. Their inward aspect is well shown in *fig.* 13. They are the emunctories of the eye; and their function is to absorb the fluids presented to them, and convey them by two converging canals (*fig.* 14, *a*) to the lachrymal sac (*fig.* 14, *c*), which they enter by a common orifice (*fig.* 14, *b*). This is a membranous bag about as large as a kidney-bean lodged in a groove in the lachrymal bone, behind the tendon of the orbicular muscle. The lachrymal sac entering a vertical channel in the bone at the end of the groove is narrowed into the lachrymal canal (*fig.* 14, *d*), and passes directly downwards into the inferior meatus or chamber of the nose, which it enters on the outer side by a slit in the mucous lining. It is not exactly understood in what way the puncta absorb—whether by capillary attraction or by some vital force of suction. The side of the lachrymal sac is connected with the tendon of the orbicularis, which may aid in producing the effect by suddenly drawing its membranous surfaces apart. We all know the effect of repeated winking when the eyes are filled with tears.

Nervous and Vascular Constitution of the Eye.—Enough has been already said, for general information, with respect to the blood-vessels distributed to the eyeball, and it is not necessary to mention those which supply the appendages. With respect therefore to vascular arrangements we have only to add, that although there are abundant proofs of the existence of an active absorption within the globe, no lymphatic vessels especially destined to that function have been hitherto found in it. The optic or second cerebral nerve has been already described. All the straight muscles, with the exception of the rectus externus, the inferior oblique, and the levator palpebræ, are supplied by the third nerve. The fourth is wholly distributed to the trochlearis, and the sixth to the rectus externus. The orbicular muscle is supplied, like most of those of the face, by the portio dura of the seventh pair. All these, except the optic, are muscular or motor nerves. The fifth nerve supplies the whole organ in common with many other parts with ordinary sensation. Any account of the intricate nervous constitution of the iris would be here quite out of place. The third and sixth nerves are mainly concerned in it. Thus of the ten cerebral nerves, the second, third, fourth, and sixth are wholly, and the fifth and seventh partially distributed to the organ of vision; a fact which may give some idea of the elaborate organisation and varied exigencies of the parts which compose it.

Comparative Anatomy of the Eye.—The sense of sight is undoubtedly developed amongst the lowest class of animals, but it is difficult to point out the exact members of the series in which this faculty is first exercised. The moving zoospores of plants are attracted towards the light, and Ehrenberg regards as eyes the red spots seen in some organisms, such as *Volvox*, which are now regarded as plants. All anatomists are agreed on regarding the ocelliform spots situated at regular intervals along the margin of the disc of Pulmograde *Medusæ* as eyes. They are composed of a collection of pigmentary granules, superposed upon an enlargement of a nervous thread, which comes from the central circle of nervous matter in the animals. Similar spots have been observed at the extremities of the rays in the *Asteriadæ* by Professor E. Forbes. In many of the lower *Articulata* no higher development obtains. In the *Entozoa* no visual organ has been detected. Distinct eye-spots are seen in the Leeches, the *Rotiferæ*, and the Dorsibranchiate *Annelida*. Amongst the mass of *Mollusca* these organs are not observed. They are however very distinct in the Pectens and other swimming forms of Lamellibranchiate Mollusks.

"The eyes of most of the higher articulated animals are constructed upon the composite type, each of the masses that is situated upon either side of the head, being made up of an aggregation of simple eyes, every one of which is in itself a complete visual instrument, but is adapted to receive and to bring to a focus only those rays which come to it in one particular direction. In most insects each composite eye forms a large hemispherical protuberance, which occupies a considerable part of the side of the head, and when examined with a microscope, its surface is seen to be directed into a vast number of facets, which are usually hexagonal. The number of these facets, every one of which is the cornea of a distinct eye, is usually very great. Behind the cornea is a layer of dark pigment, which takes the place and serves the purpose of the iris in the eyes of the *Vertebrata*, and this is perforated by a central aperture or pupil, through which the rays of light which have traversed the cornea gain access to the interior of the eye. When a vertical section is made of one of these composite eyes, it is seen that each separate eye is the frustum of a pyramid, of which the cornea forms the large end or base, whilst the small end abuts upon a bulbous expansion of the optic nerve. The interior of this pyramid is occupied by a transparent substance which represents the vitreous humour, and the pyramids are separated from each other by a layer of dark pigment which completely incloses them, save at the pupillary apertures and also at a corresponding set of apertures at their smaller ends, where the pigment is perforated by the fibres of the optic nerve, of which one proceeds to each separate eye. Each facet of the common cornea or 'corneule' is usually convex on both its surfaces, and thus acts as a lens, the focus of which has been ascertained by experiment to be equivalent to the length of the transparent pyramid behind it; so that the image produced by the lens will fall upon the extremity of the filament of the optic nerve which passes to its truncated end. The rays which have passed through the several corneules are prevented from mixing with each other by means of the layer of black pigment which surrounds each cone; and thus no rays, except those which correspond with the axis of the cone, can reach the fibres of the optic nerve. Hence it is evident that each separate eye must have an extremely limited range of vision, being adapted to receive but a very small pencil of rays proceeding from a single point in any object; and as these eyes are usually immoveable, they would afford but very imperfect information of the position of surrounding objects, were it not for their enormous multiplication, by which a separate eye is provided (so to speak) for each point to be viewed. No two of the separate eyes, save those upon the opposite sides of the head which are directed exactly forwards, can form an image of the same point at the same time, but the combined action of all of them may give to the insect, it may be imagined, as distinct a picture as that which we obtain by a very different organisation. At any rate it seems certain, from observation of the movement of insects, that the vision by which they are guided must be very perfect and acute.

"Although the foregoing may be considered the typical structure of the eyes of insects, yet there are various slight departures from it in the different subdivisions of the class. Thus in some cases the posterior surface of each corneule is concave, and a space is left between it and the iris which seems to be occupied by a watery fluid or aqueous humour; in some instances again this space is occupied by a double convex body which seems to represent the crystalline lens; and there are cases in which this crystalline lens is found behind the iris, the number of eyes being reduced, and each individual eye being larger, so that the entire aggregate approaches, both in its structure and mode of action, to that of *Arachnida* and certain *Crustacea*. Besides their composite eyes, insects usually possess a small number of rudimentary single eyes resembling those of the *Arachnida*: these are seated upon the top of the head, and are called stemmata. Their precise use is unknown, but that they have considerable influence in the direction of the movements appears from the fact that, if the stemmata of a bee be covered with paint, on being let go it will fly continually upwards—a fact which seems related to those already mentioned in regard to the influence of visual sensations upon automatic movements. It is remarkable that the larvæ of insects which undergo a complete metamorphosis only possess simple eyes, the composite eyes being developed at the same time with the wings and other parts which are characteristic of the imago state during the latter part of the pupa condition. In the higher *Crustacea* the structure of the eyes is nearly the same as in insects; but the compound masses are not so large relatively to the bulk of the body, and the number of distinct eyes is not nearly so great. In the lower *Crustacea* however, as in *Myriapoda*, the visual organs much more closely approximate the type of structure which they present in the *Arachnida*; each aggregate mass being composed of a small number of simple eyes, of which every one has its own separate cornea as well as its own crystalline lens and vitreous humour, and these in some instances being altogether detached from each other. Among some of the Suctorial *Crustacea* the visual organs are altogether wanting in their state of full development, although they are uniformly present in their early condition; and the same may be said of the *Cirrhipedia*. Among *Arachnida*, which in this as in many other respects present an approximation to *Vertebrata*, we find a great reduction in the number of eyes, which are never more than eight in number (sometimes being only two), and are to be compared with the stemmata of insects rather than with their compound eyes. These eyes are sometimes collected into one mass on the summit of the cephalo-thorax, and are sometimes symmetrically and separately on the two sides of the median line. In the Scorpions we find two large eyes placed on the dorsal aspect of the cephalo-thorax near the median line, and three pairs of smaller ones, which are placed on the outer margins of the same division of the body. The larger eyes are described by Müller as each possessing a cornea which is convex anteriorly and concave posteriorly; and a nearly globular crystalline lens resembling that of fishes, whose anterior surface lies in the hollow of the cornea, while its posterior rests upon the vitreous humour, without being imbedded in it. The vitreous humour is a nearly hemispherical mass of soft granular matter, being almost flat in front and very convex behind; over its posterior surface is spread the retina, or expansion of the optic nerve; and this is covered by a thick layer of pigment which passes inwards in front of the vitreous humour so as to form a sort of iris, the pupillary aperture of which however exceeds the diameter of the crystalline lens. Among those classes which constitute the higher division of the Molluscous series in virtue of the possession of a distinct head, the presence of visual organs is by no means constant; many *Gasteropoda* and *Pteropoda* being destitute of them altogether, and others possessing ocelliform spots, which may be concluded to be rudimentary eyes from their similarity in position to the eyes of those which undoubtedly possess visual powers. The eyes are always very minute however in proportion to the bulk of the body, and in no instance do they possess a high type of structure; their general organisation indeed bears a close resemblance to that which has been described in the eye of the Scorpion. In the *Cephalopoda* we find the visual organs presenting a much larger size, and attaining a much higher grade of development, in accordance with their greater functional activity in directing the rapid and energetic movements practised by a large proportion of these animals. We here find nearly all the principal parts which are characteristic of the eye of higher animals, namely, a cornea, an anterior chamber filled with an aqueous fluid inclosed in a distinct capsule, a crystalline lens of globular form (as in fishes), a large posterior chamber filled with vitreous humour, a tough fibrous or sclerotic coat, a vascular choroid coat within this covered by black pigment upon its inner surface and retinal expansion. The relations of this last to the optic ganglion however are very peculiar. This ganglion is situated almost close to the back of the eye, and instead of transmitting a single optic nerve as in higher animals, it gives off a multitude of filaments which separately pierce the sclerotic coat, and then form a plexus between this and the choroid, which has been mistaken for the retina. The true retina however is a very thin lamella apparently composed of vesicular nerve-substance, which is found between the pigment and the membrane inclosing the vitreous humour; but the connection of this with the net-work of nerve-tubes on the outside of the pigmentary layer has not yet been made out. No proper iris exists in the eyes of the *Cephalopoda*, but its place is supplied by a partial prolongation of the sclerotic coat over the front of the crystalline, a central pupillary aperture being left. The cornea is not, like the true cornea of higher animals, a transparent continuation of the sclerotic coat, but is a modification of the general integument, analogous rather to the external or conjunctival layer of the cornea of *Vertebrata:* it is remarkable that in some *Cephalopoda* it should be perforated by an orifice of considerable size, through which the capsule of the crystalline lens projects into the external medium." (Carpenter, 'Principles of Physiology.')

The eyeballs of quadrupeds and other *Mammalia* resemble the human organ in structure, and differ from it, but not essentially, in form. This is not the case with the appendages. One of the most remarkable additions commonly found to the parts we have described is that of a strong retractor muscle in the shape of a hollow cone attached at the apex to the bottom of the orbit, and by the marginal base to the sclerotic, which it embraces, lying under the recti muscles. Its use is to draw back the eye in the orbit, a gesture which gives a very peculiar expression of hollowness to the organ in beasts of prey.

We subjoin the following account of the eye of the Common Owl (*Strix bubo*), chiefly for the purpose of explaining the pecten and the curious mechanism of the third eyelid, or nictitating membrane, in birds.

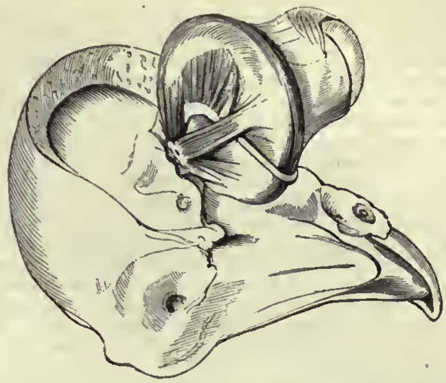
The general shape of the organ represented in the annexed figures resembles a bell. This arises from the disposition of a series of quadrangular bony scales (*fig.* 15, *a*) within the substance of the sclerotic, concave on their outer aspect, and overlapping and accurately fitted to each other. The rigidity thus communicated to the external case which contains the fluid media prevents their pressure from distending the eye into a spherical shape. The ciliary body (*fig.* 15, *b*) extends over the whole of this portion of the surface. A curious membrane called the pecten or comb (*fig.* 15, *c*), from some resemblance to that implement, projects through the choroid into the vitreous humour, and in some birds is attached to the side of the lens. In the owl it is comparatively short. It resembles a quadrangular piece of choroid folded backwards and forwards upon itself like the paper of a lady's fan. Of its use little is known. The foramen of Soemmering, described in the account of the human retina, is thought to be a rudiment of the pecten. In birds the retina has generally the yellow colour seen only partially in man round the central spot miscalled a foramen.

Fig. 15.

Horizontal section of the eye of the Common Owl (*Strix bubo*). *a a*, bony plates in the sclerotic; *b*, ciliary body; *c*, pecten.

At the back of the globe there are two muscles which originate from the sclerotic, and are applied to its curved surface round the

Fig. 16.



Head of the same bird. A portion of the bony margin of the orbit having been removed, the eyeball is turned forward so as to show the recti and other muscles.

entrance of the optic nerve. (*Fig.* 17, *a.*) The larger represents rather more than half of what if completed would be a broad circular ring. (*Fig.* 17, *b.*) It is called the quadratus. Attached by its wider edge near the margin of this part of the sclerotic, its fibres converge to the narrower edge, and terminate in a narrow tendon (*fig.* 17, *c*), perforated through its whole length like the hem of an apron. The second smaller muscle, called the pyramidalis from its shape (*fig.* 17, *d*), at an opposite part of the circumference. Its fibres converge, and are fixed into a long round tendon (*figs.* 17 and 18, *e*), which passes through the loop or hem (*c*) of the quadratus, and hence turning over the edge of the broad part of the sclerotic, is continued along the surface of its bell-shaped portion, where it passes through several thread-like loops or pulleys which keep it applied to the concavity, and round a bony point which projects from the surface, and is

Fig. 17.

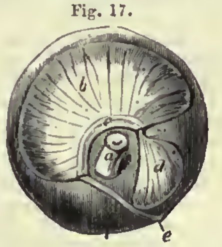


Fig. 18.

Fig. 17. Posterior view of the sclerotic of the same bird, showing the muscles of the nictitating membrane. *a*, optic nerve; *b*, quadratus muscle; *c*, its looped tendon; *d*, pyramidalis muscle; *e*, its tendon—having passed through the loop in that of the quadratus—turning over the edge of the sclerotic.

Fig. 18. Lateral view of the same part. *e*, the tendon of the pyramidalis, attached to the concave part of the sclerotic by tendinous loops, and passing round a prominent bony tubercle, is seen inserted into the nictitating membrane at *f*.

attached near the edge of the cornea to the edge of an elastic fold (*fig.* 18, *f*) of the conjunctiva, which is called the third eyelid or nictitating (that is, winking) membrane. It will be easily seen by the help of the figures, from this description, that the effect of the simultaneous contraction of the two muscles will be to draw the membrane with great rapidity, making it sweep over the surface of the cornea. It returns by its own elasticity with nearly equal quickness. A bird may be seen to use this mechanism twenty times in a minute; in fact, as often as it may be necessary to cleanse the surface of the eye. The colour of the membrane is milky; and it is seen to pass from the upper and inner to the outer and lower corner of the eye with the speed for which the act of winking is proverbial. There is a rudiment of this third eyelid in the human organ. It is a small crescentic fold of conjunctiva situated at the inner canthus behind the caruncle. (*Fig.* 13, *f.*) The haw is also a rudiment of it, in the eyes of quadrupeds; it is occasionally forced out by the pressure of the globe against the nasal side of the orbit, being unprovided with muscles.

Seat of Vision.—The retina in one sense is not the seat of vision. It is necessary to the perception that the impression of light should be received on another part not endowed with sensibility, namely the surface of the choroid; and that the vibration or other effect thus impressed should be transferred to the retina in front of that surface; for where the choroid is deficient at the entrance of the nerve, there is no perception of light. This may be easily shown by a very common and conclusive experiment. If two discs of white paper be fixed upon a wall at the distance of two feet from each other, and an observer, having closed one eye (the left), continues to gaze attentively at the left-hand disc, at the same time slowly retreating from the wall, he will for a time continue to see them both; the rays from the right-hand object entering of course laterally, and impinging upon the retina nearer and nearer to the entrance of the nerve as he goes backward. At length when he has reached the distance of about 6¼ feet from the wall, the right-hand object will suddenly disappear, and remain invisible (the observer still retreating) till he has gained a distance of about eight feet. During this period the spectrum has been passing over the circular aperture in the choroid through which the nerve enters. The insensible portion of the retina is found to extend horizontally over five degrees and a half of the angular range of vision. The eyes are generally unequal in power, and the experiment succeeds best in the weaker organ, in which the obscuration is more sudden and complete. In the experiment previously mentioned, showing the distribution of the central artery of the retina, the surface of the choroid is faintly illuminated through the transparent nervous expansion by what is called the dispersion of part of the light admitted through the pupil; but the rays thus scattered are locally intercepted by the opaque blood contained in the minute branches of the artery; hence, after several repetitions, when the eye has become accustomed to neglect the taper, and attend to the fainter internal illumination, the shadow of the vascular net-work upon the choroid becomes perceptible in dark lines.

Apparent Direction of Objects seen obliquely.—A body in motion, as a ball, striking the surface of another, impresses it in a line perpendicular to the surface at the point of impact. This rule appears to hold good with respect to the action of light upon the retina. Indeed if impressions of any kind be made upon it, the sensation is that of light, and the direction suggested is that of a line joining the centre of the sphere of which the retina forms a part with the point impressed,—in other words, a line perpendicular to it. This may be shown in several ways: if we excite the nerve by pressing far back upon the eyeball with the finger-nail, especially if the eye be closed or light otherwise excluded, a bright ring appears to be seen in a diametrically opposite quarter.

Erect Vision.—If the sclerotic and choroid be carefully removed under water from the back of an eye, an inverted picture of any object held before the cornea is seen upon the now milky surface of the retina. Hence the celebrated question raised in the age of philosophical barbarism, how is it that we see objects erect when the image on the retina is inverted? The question is an idle one, which is perhaps hardly worth answering. The mind judges of the apparent place of objects or of parts of an object by the direction of the impressions made upon the retina, not by the part of it which may happen to be affected by these impressions. The shadow of the central artery is an example of an impression necessarily received always upon the same parts; yet the apparent, or in other words the relative, place of the shadow will be found to vary with every movement of the eye.

Single Vision.—Another question, not so trivial as the last, has been raised with respect to single vision with two eyes, as the impression must be twofold. But perhaps it will not require an answer if the reader will try to imagine double vision of the same object, or rather of the same point, for the question resolves itself into that. Let the two supposed images approach each other, still remaining double, till they are in contact. Another step in the imaginary approximation, and they are one. The truth is, that both eyes see the object in the same place; and as two images, no more than two material substances, can occupy the same place at the same time, the impressions coincide and are single.

On the Development of the Organ of Vision.—The following remarks on this subject are from Professor Kölliker's 'Manual of Human Histology:'—

"The eyeball is not developed from a single point as a whole, but arises from the conjunction of formations, proceeding on one side from the central nervous system, on another from the skin, and thirdly from the parts lying between the two.

"In the Chick the primitive ocular vesicles arise before the commencement of the second day, from the primitive cerebral vesicle or the anterior cerebrum, in the form of two protrusions at first sessile, but afterwards having a hollow peduncle—the rudiment of the optic nerve. At the beginning of the third day the formation of the lens commences, from the skin of the face covering these vesicles by the thickening on the inner aspect and inversion of the epidermis, in consequence of which the anterior wall of the primitive ocular vesicle is also inverted, and becomes applied to the posterior wall, so that the cavity of the vesicle is wholly obliterated.

"Now, at first this secondary ocular vesicle encompasses the lens, which in the meantime has been separated by constriction from the epidermis, and comes into exact apposition with it beneath; like a cup subsequently however the vitreous body is developed between the two in a special new cavity. How the latter is formed has not yet been ascertained, although, as Schöler observes, it is most probable that it also grows in from the skin, in fact from the region below and behind the lens, and participates with the latter in the inversion of the primitive ocular vesicle. According to Remak, the retina is formed from the inner thicker wall of the inverted or secondary ocular vesicle, and from the outer and thinner, the choroid, from the anterior border of which the iris is not produced till afterwards. The sclerotic and cornea are applied from without upon the eyeball thus constituted, the former being to some extent a production of the skin. An interesting phenomenon is presented in the vessels existing in the fœtal eye, even in the transparent media. The vitreous body on its outer surface, between the hyaloid membrane and the retina, presents a tolerably wide meshed vascular plexus, which is supplied by branches of the arteria centralis retinæ, given off from it at its entrance into the eye, and anteriorly, at the border of the lens on the zonula Zinnii forms a vascular circle, the circulus arteriosus Mascagnii, from which again vessels are given off to the membrana capsulo-pupillaris presently to be described. Besides this, a special arteria hyaloidea, also derived from the central artery of the retina, runs in the so-called canalis hyaloideus, in a straight line through the vitreous body to the lens, and ramifies in the most elegant arborescent manner at very acute angles in a membrane closely applied to the posterior wall of the lenticular capsule. This is nothing else than a portion of an externally vascular capsule which at first very closely surrounds the lens, and in its anterior walls is supplied by the continuation of the hyaloid artery coming round the border of the lens towards the front, with which branches of the circulus arteriosus Mascagnii and of the anterior border of the uvea are connected. Afterwards, when the lens retreats from the cornea, with which it is at first in close apposition, and the iris buds out from the border of the uvea, the anterior wall of the vascular lenticular capsule is divided into two portions, one central and anterior, which, arising from the border of the iris, and connected with that membrane by vessels, closes the pupil, the membrana pupillaris; and another external and posterior, extending backwards from the same points on the border of the lens, the membrana capsulo-pupillaris. The latter becomes more and more distinct as the iris and aqueous chambers are developed, and the lens retreats until at last it represents a delicate membrane stretching across the posterior chamber.

"The venous blood from all these parts is returned through the veins of the iris and from the outer surface of the vitreous body, also through those of the retina, and perhaps through a vena-hyaloidea said to take the same course as the artery, but of the existence of which many authors doubt, and which I have never myself seen. With respect to the genetic import of the vascular capsule, nothing has as yet been ascertained. I find it to be composed of a homogeneous tissue, with a few scattered cells, and regard it as a structure corresponding to the cutis which in the formation of the lens is detached from the skin, together with a portion of the epidermis, and remains in the eye. The vitreous body then may be understood as modified subcutaneous connective tissue—a supposition not at all incongruous with the observations above adduced, and the more so because, as I have shown, all the subcutaneous connective tissue of the fœtus is at one time perfectly gelatinous, and, like the enamel organ, which also belongs to the same tissue, in specie strikingly resembles the vitreous body in aspect and consistence.

"Concerning the histological development of the eyes, the following only need be remarked. At an early period they consist in all their parts of formative cells of uniform size, which in process of time are metamorphosed into the various tissues. In the fibrous coat in the second and third month the cells are developed in the mode already described into connective tissue, and at the same time the distinction is set up between the cornea and sclerotic, which are at first externally exactly alike, and constitute only a single membrane. In the uvea the cells are for the most part employed in the formation of vessels; another portion goes to the formation of the inner and outer pigment layers, pigment granules being deposited in them at the commencement of the third month, whilst another is transformed into muscles, nerves, the epithelia and connective tissue of these membranes. The development of the nerve-cells and of the so-termed 'granules' from embryonic cells, may be readily traced. I have observed the same thing also with respect to the 'cones,' and I think that in the Frog it may be assumed with respect to the 'rods' likewise, that they are nothing but elongated cells; whilst in the *Mammalia* the formation of the rods and of the nerve-fibres themselves, has not yet been traced. The lens, lastly, is originally composed entirely of cells, which in course of time are transformed into the tubes.

"The precise nature of the processes attending these changes has not yet been investigated, although I agree with H. Meyer in the conclusion, that, since the tubes, both in the fœtus and child, present only a single nucleus, each of them is developed out of a single cell. These nuclei, taken as a whole, constitute a thin layer extending from the borders of the lens, through the middle of its anterior half, and slightly convex in front ('nuclear zone,' Meyer); the nuclei being smaller in the interior portions, and, as it were, in progress of solution, whence it may certainly be concluded that the lens increases by the apposition of thin layers from without. The formative-cells of the tubes of the lens are those which exist on the anterior half of the capsule, and the starting-point of the formation of the lenticular elements, according to my observation, is the entire anterior surface and the border of the organ. Nuclei are visible in the tubes even in the lens of the adult, as was known to Harting, though only at its margin."

(Kölliker, *Manual of Human Histology*, translated by Busk and Huxley for Sydenham Society; Valentin, *Text-Book of Human Physiology;* Todd and Bowman, *Physiological Anatomy;* Carpenter, *Principles of Physiology;* Jones, *Actonian Prize Essay on the Eye.*)

EYEBRIGHT. [EUPHRASIA.]

F

FABA, a genus of Plants belonging to the natural order *Leguminosæ.* It has a tubular 5-cleft or 5-toothed calyx, with the two superior teeth shortest. The style is villous at the apex. The legume is large and coriaceous, lined with short hairs, and containing several large flat seeds. The leaves are almost without tendrils, and the stem is erect. The flowers are white or red.

F. vulgaris, the Common Bean, has thick leaves with 2-5 broad oval mucronate leaflets. It has semi-sagittate oval stipules, and the teeth of the calyx are almost linear.

This plant is much cultivated, and subject to considerable variety. Its seeds differ, being sometimes round and comparatively small, at other times large and flat. The flowers are mostly white, with a blackish-blue silky spot in the middle of the two lateral petals called wings. The Common Bean is said to be found wild in Persia, not far from the Caspian Sea, but it is one of those plants, which, having from time immemorial been cultivated by man, may have anywhere been introduced by his agency. It does not occur wild in the countries of Europe, where it grows most luxuriously under the care of man. For an account of the culture and properties of this plant and its uses, see BEANS, in ARTS AND SC. DIV.

FABACEÆ, *Leguminous Plants*, a name proposed by Lindley in his 'Vegetable Kingdom' for the natural order *Leguminosæ.* [LEGUMINOSÆ.]

FABOI'DEA, Mr. Bowerbank's generic title for Seed-Vessels found in the London Clay of Sheppey. ('Fossil Fruits of the London Clay.')

FÆCULA. [STARCH.]

FAGOPYRUM, a genus of Plants belonging to the natural order *Polygonaceæ.* It has a 5-parted perianth, 8 stamens, 3 styles, a 1-seeded trigonous nut, a central embryo, and large foliaceous contorto-plicate cotyledons. There is but one British species of this plant, the *F. esculentum.* This is the *Polygonum Fagopyrum* of Smith, and known as the common Buck-Wheat. It has an erect stem without prickles, the flowers in cymose panicles, 8 stamens, leaves cordate, sagittate, acute, a triquetrous acute nut, with entire angles. This is a valuable plant, as it grows on the worst and poorest soils, and is often sown as food for game. Though now admitted into the British Flora, there can be no doubt that it was originally a native of Persia and other Asiatic countries. It was introduced into Europe by the Crusaders; and hence in many parts of France, where it is commonly grown, is called Saracen Corn; and so much is it esteemed in Belgium, that M. Bory St.-Vincent says he was shown the tomb of the person who is reported to have first brought it into that country. [BUCK-WHEAT, in ARTS AND SC. DIV.]

(Babington, *Manual of British Botany;* Burnett, *Outlines of Botany.*)

FAGUS (from φάγω, to eat), a genus of Plants belonging to the natural order *Corylaceæ.* This order is characterised by its male flowers being arranged in catkins, and the female flowers being solitary or on spikes, and the fruit surrounded by a coriaceous involucre. The genus *Fagus* has its stamens in a globose catkin; the perianth 5-6-fid; the stamens 8 to 15 in number; the pistilliferous flowers are 2 together, and contained within a 4-leaved prickly involucre; the stigmas 3; the ovaries 3-cornered and 3-celled; the fruit is a nut, which by the suppression of the ovules and cells is only 1- or 2-seeded. The species are large handsome deciduous trees, natives of Europe, North and South America, and Australia. The best known species is the Common Beech, which is a native of Great Britain.

F. sylvatica, the Wood-Beech or Common Beech. It has ovate glabrous obsoletely-dentate leaves, ciliated on their margins. It is a tree varying from 60 to 100 feet in height. It is a native of various parts of Europe besides Great Britain, and a variety is found in North America. Loudon, in his 'Arboretum et Fruticetum Britannicum,' gives the following varieties:—

F. s. purpurea, the Purple-Beech, which has the buds and young shoots of a rose-colour.

F. s. cuprea, the Copper-Coloured Beech, in which the young shoots and leaves are of a paler colour than in the last.

F. s. foliis variegatis, the Variegated Beech, in which the leaves are white and red, interspersed with streaks of red and purple.

F. s. heterophylla, the Cut-Leaved Beech, in which the leaves are separated in various ways.

F. s. cristata, the Curled-Leaved Beech. The leaves are curled up in this variety.

F. s. pendula, the Weeping Beech, in which the branches are pendulous.

F. s. Americana, the White Beech. This is the American form of the Common Beech.

The Beech is remarkable for its smooth thin bark, which becomes white when fully exposed to the air. In the midst of it those knobs called embryo-buds, or abortive branches, are more often found than in any other tree. They are sometimes used by cabinet-makers and turners on account of their hardness. At the Great Exhibition of 1851 a chair was exhibited composed entirely of these knobs. The leaves are shining and thin, changing to a brown or russet colour in the autumn, and often remaining on the tree throughout the winter. Its branches are numerous, and its foliage so dense that other plants do not thrive under it; so that there is seldom any vegetation seen on the ground in a beech forest. The *Monotropa Hypopithys*, Bird's-Nest Orchis as it is called, is often found parasitical upon its roots. The fruits contain a nut or seed, which when ripe frequently drops out, leaving the husk upon the tree. The seeds are not disagreeable to the taste. Squirrels are fond of them, and are often found seeking them on these trees. The beech-trees in the forests of Germany generally attain the age of about 200 years. There is one in Windsor Forest which is supposed to have been in existence before the Norman Conquest.

The wood of the Beech-Tree when green is harder than that of any of our forest-trees. It is very generally used in the arts for all purposes where strength is required, and where the action of water is to be resisted. On the Continent, and especially in France, one of the most important uses of this wood is for making wooden shoes called sabots. They have the property of not absorbing water, and surpass the sabots of all other wood, except those made of walnut, which are much dearer.

As fuel the wood of the Beech is superior to that of most other trees. It is consumed for this purpose to a great extent in France and Germany. It burns rather rapidly, but throws out a great deal of heat, and makes a clear bright flame.

The fruit, the nut of which is called Beech-Mast in England, and la Faine in France, has a taste somewhat approaching to that of the hazel-nut. It forms an excellent food for swine, but the flesh of those which are fattened upon it does not keep so well as that of those fed on acorns. Beech-mast is sought after by wild animals, such as badgers, dormice, &c. Beech-oil, expressed from the nuts, is used in cooking, also for burning in lamps. For useful plantations the Beech is not highly prized; it is chiefly valuable as an ornamental tree for the park and the lawn. It is subject to the attacks of comparatively few insects; those which do infest it belong chiefly to the *Lepidoptera*, and are in the caterpillar state. The fungi which grow on the Beech in Great Britain are rather numerous: various species of *Agaricus, Boletus, Polyporus, Peziza, Stromatosphæria*, and *Stilbum* are mentioned. The most remarkable fungi growing beneath the Beech-Tree are—*Geoglossum viride, Helvella esculenta*, and *Morchella esculenta*, the common Morel. The last two species are celebrated luxuries for the table. *Morchella esculenta* grows in great abundance in the woods of Germany and France, particularly after any of the trees have been burned down. This having been observed, led in Germany to the practice of burning the trees in order to produce Morels, and consequently great numbers of them were destroyed till it was forbidden by law.

F. ferruginea, the American Ferruginous-Wooded Beech, is a North American timber-tree, so much resembling the common European Beech as to be considered by some to be only a variety of it. It has ovate acuminate thickly-toothed leaves, downy beneath, ciliate on the margin. The American Beech is easily known from the European one by its much shorter obtusely-pointed buds, with short roundish convex scales, which terminate almost abruptly, and are inclosed in numerous short loose scales. There are two varieties of this species—*F. Caroliniana* and *F. latifolia.*

F. obliqua, the Oblique-Leaved Beech, is a native of Chili. It has ovate-oblong oblique leaves, somewhat rhomboid, blunt, doubly serrated, entire at the base, attenuated into the petiole, somewhat downy.

F. betuloides, the Birchlike or Evergreen Beech, grows at Port Famine, Straits of Magalhaens, in the greatest abundance. It attains a very large size, trees of three feet in diameter being common, and there being many with trunks four feet in diameter. This Beech is also a native of Van Diemen's Land, where it is called the Myrtle-Tree by the colonists. It has ovate-elliptic leaves, obtuse, crenulate, leathery, shining, glabrous, round at the base, on short footstalks. The branches are divaricate, tortuous, brownish, the young ones pubescent, the leaves ciliate, alternate, from 4 to 10 lines long, and from 3 to 8 lines broad. The flowers are axillary. It is an evergreen tree, and forms vast forests in Tierra del Fuego, where it is a native.

F. antarctica, the Antarctic Beech, is a native of Tierra del Fuego.

F. Dombeyii, Dombey's or the Myrtle-Leaved Beech, is a tall tree, a native of Chili, where it is known by the name of Coigué, and furnishes excellent wood for the purposes of construction.

F. dubia, the Dubious Beech, is thought only to be a variety of *F. betuloides.* By some botanists, however, it is considered a distinct species, and is described as such.

FAHLORE, *Fahlerz*, Gray Copper Ore. Of this there are two varieties, the arsenical and the antimonial: the former occurs crystallised and massive. The primary form of the crystal is a cube, but the regular tetrahedron is the predominating crystal. Colour steel-gray, opaque. Lustre metallic. Specific gravity 4·8 to 5·1. Hardness 3·0 to 4·0, brittle. Cleavage parallel to the planes of the tetrahedron, very indistinct. Fracture conchoidal.

Massive Variety.—Amorphous. Structure granular to compact.

It occurs in Cornwall, Hungary, Saxony, &c. A specimen from Freiberg, analysed by Klaproth, yielded—

Arsenic	24·10
Copper	41·00
Iron	22·50
Sulphur	10·00
Silver	·40
Loss	2·00
	100

It frequently contains a much larger quantity of silver, and not uncommonly zinc.

Antimonial Fahlore.—It occurs crystallised in modified tetrahedrons. The colour dark lead-gray, approaching to iron-black, both externally and internally: not very brittle.

Analysis of a specimen from Kapnic by Klaproth:—

Antimony	22·00
Copper	37·75
Iron	3·25
Sulphur	28·00
Silver, and a trace of Manganese	·25
Zinc	5·00
Loss	3·75
	100

FAHLUNITE, *Tricklasite*, a Mineral consisting of silicate of alumina and other substances. It occurs crystallised and massive. The primary form of the crystal is a right rhomboid prism, but it usually occurs in imbedded, regular, hexagonal prisms. Colour yellowish, greenish, and blackish-brown. Nearly or quite opaque. Lustre resinous. Specific gravity 2·66. Hardness 5·0 to 5·5. Streak grayish-white. Cleavage perpendicular to the axis of the prism.

It is found at Fahlun in Sweden.

Before the blow-pipe alone it becomes gray, and fuses on its thinnest edges; with borax it melts slowly into a coloured glass.

According to Hissinger it consists of—

Silica	46·74
Alumina	26·73
Magnesia	2·97
Oxide of Iron	5·11
Oxide of Manganese	0·43
Water	13·50
	95·48

FALCIFERI. [AMMONITES.]

FALCO. [FALCONIDÆ.]

FALCON. [FALCONIDÆ.]

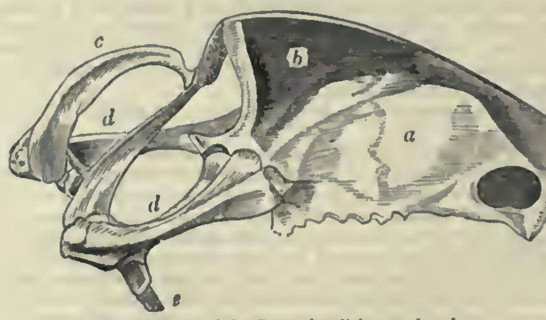
FALC'ONIDÆ, Leach's name for a family of Raptorial Birds, or birds of prey (Raptores of Illiger). In this family the destructive power is considered by all zoologists to be most perfectly developed; and we find in the birds composing it natural instruments for striking, trussing, and dissecting their prey, combined with a power of flight and strength of limbs equivalent to the necessities of the case, whether the prey be aërial, that is, whether it be the habit of the raptorial bird in question to strike down its quarry while the latter is in the act of flight, or whether the prey be terrestrial, or, in other words, captured on the ground. Of these natural weapons some idea may be formed from the cuts here given; and they are rendered still more

Bill of the Peregrine Falcon (*Falco peregrinus*).

formidable by the organisation of the whole animal, which is calculated to give them the greatest possible effect. The nails or claws, to be available, must be sharp; and in order that they may be kept in this state and fit for duty, there is a provision to enable the bird to prevent them from coming in contact with the ground or other foreign hard bodies; for the claws are retractile, not indeed in the same manner as those of the cats [FELIDÆ], which have the power of withdrawing or sheathing theirs within the integuments, but by a conformation which gives the bird of prey the power of elevating its claws at pleasure. The claws of falcons when sitting on stones or large branches of trees have often a cramped appearance; but this arises in most instances from the care of the bird so to arrange talons that their points may not be blunted against the perch.

Foot of the Peregrine Falcon (*Falco peregrinus*).

The power of flight, as Mr. Yarrell observes in his memoir 'On the Anatomy of Birds of Prey' ('Zool. Journ.,' vol. iii.), is one of the decided marks of the distinct organisation of birds; and, as one division of the first genus, *Falco*, appears to possess this power in the highest degree of perfection, he proceeds to consider the conditions necessary to produce such a degree. These, he observes, are large and powerful pectoral muscles; great extent of surface, as well as peculiarity of form in the wing; and feathers of firm texture, strong in the shaft, with the filaments of the plume arranged and connected to resist pressure from below. "A certain degree of specific gravity," continues Mr. Yarrell, "is necessarily imparted by large pectoral muscles, and the power of those muscles may be estimated by the breadth of the sternum and the depth of its keel, as affording extent of surface for the attachment of the large muscle by which the wing is depressed. As an illustration of this form the breast-bone of the Peregrine Falcon (*Falco peregrinus*) is represented, which exhibits the



Breast-bone of the Peregrine Falcon reduced.

a, the sternum; *b*, the keel; *c*, the furcula, or os furcatorius; *d d*, the clavicles; *e*, the scapula broken off.

breadth of the sternum, the depth of the keel, as well as the strength of the clavicles; and the power of flight peculiar to all the species of true falcons is still further illustrated by the form and substance of the os furcatorius, which is circular, broad, and strong, affording a permanent support to the shoulders. That the long and acuminated form of the wing in the true falcons, with each feather narrow, firm in consistence, the second the longest, and all gradually tapering to a point, is also best adapted for rapidity of motion, may be inferred from the example in the various species of the genera *Hirundo*, *Scolopax*, *Tringa*, *Charadrius*, *Procellaria*, *Sterna*, &c.; but that extent of surface and this peculiarity of form in the wing are not in themselves sufficient alone to afford rapid flight, is proved in the genus *Larus*, the species of which, though capable of exercising their immense pinions with graceful ease for hours in succession, without any apparent lassitude, are still incapable of rapid flight, for want of strong pectoral muscles. The numerous examples also furnished by the Gallinaceous tribe sufficiently evince that immense pectoral muscles are insufficient when coupled with a small round wing, and afford but a short flight, sustained with great labour, rapid in a small proportion only to the strength and repetition of the impulse, and accompanied by a vibration too well known to need further remark. So material also is the perfection of the feather in the genus *Falco*, that when any of those of the wing or tail are broken, the flight of the bird is so injured that falconers find it necessary to repair them. For this purpose they are always provided with pinion and tail-feathers accurately numbered, and the mode of uniting the more perfect feather to the injured stump is described in Sir John Sebright's excellent observations on hawking. The reader who is disposed to go farther back, will find in the 'Booke of Falconrie or Hawking,' &c. 'heretofore published by George Turbervile, Gentleman,' (Loudon, small 4to, 1611), the following chapters:—"Of Accidents that happen and light uppon a hawkes feathers, and first how to use the matter when a feather cannot be ymped." "The way and manner how to ympe a hawks feather, howsoever it be broken or bruised;" and four methods of operating, according to the circumstances, are detailed. "How to ympe the traine of a hawke beeing all broken, and never a feather whole or sound." Mr. Yarrell proceeds to observe that it is difficult to estimate the comparative rapidity of flight in different birds, and that our pigeons may appear to possess this advantage in a degree little inferior to the true falcons; but, he adds, the fact is that these birds are deficient in natural courage, and are unable, under circumstances, to avail themselves of those powers with which they are gifted.

"The bodies of all the species of true falcons when denuded of their feathers are triangular in form, broad at the shoulders and tapering gradually to the tail, the muscles of the thighs and legs of great size; but these characters are less prominent in the hawks, the bodies of which are more lengthened, the legs long and slender, the pectoral muscles smaller, the wing rounded in form, the fourth feather the longest, the wing primaries broad in the middle, the inner webs overlapping the feather next in succession, and emarginated towards the end. These two divisions of the genus *Falco*, although the latter are unequal to the former in powers, are remarkable for their bold character and rapid flight, their invariable mode of striking their prey on the wing, as well as the instinctive knowledge by which they are directed to destroy life, attacking the most vital part, and penetrating the brain with their sharp hooked beak either by one of the orbits where the bone is very thin or at the junction of the cervical vertebræ with the occiput.

"On comparing the bones of our two British eagles, the greater power of flight appears to belong to the *Albicilla*, that of prehension to the golden eagle, but both exhibit various indications of great strength.

"By an extended examination of the different species of buzzards and harriers it will be found that the characters described as necessary to produce rapid motion decline gradually. The sternum decreases in size, the keel loses part of its depth, the clavicles and furcula become more slight, while the form of the cranium, the loose ruffled feathers of the neck, as well as the general downy texture of the plumage, indicate the approach to the genus next in succession. Of the bones of the different species of the genus *Falco* generally it may be added that they are remarkable for their strength, such as are cylindrical being furnished with numerous transverse bony processes within the tubes, and the distribution of air throughout their internal cavities. The humerus is supplied with air through several orifices upon its inner and upper surface, and some difference will be found in the angle at which this bone is articulated with the clavicle to accomplish the ascending flight of the sky-lark, in contradistinction to the precipitous horizontal direction of the falcons. The thigh bone is also supplied with air by an orifice at the situation which answers to the front of the great trochanter; the large bones forming the pelvis, the vertebræ, sternum, furcula, clavicles, scapulæ, and even the ribs, are all furnished with apertures for the admission of air supplied from the various cells of the abdomen, sides, and thorax. This distribution of air to the bones does not seem however to be absolutely necessary for flight, since the young birds of our summer visiters appear to perform their first autumnal migration with perfect ease and celerity, at an age when the cavities of their bones are filled with marrow.

"The various characters of the feet are too obvious to require particular notice." (Yarrell.)

In the Museum of the Royal College of Surgeons in London the reader will find a preparation (Gallery, 522 A) of the stomach of the Golden Eagle. It is laid open so as to show the orifices of the numerous gastric glands of the proventriculus, the smooth lining membrane of the gizzard, and the valvular structure of the pylorus. The œsophagus is very wide, so that externally it appears to form one continued cavity with the proventriculus and stomach. John Hunter, in his 'Observations on Digestion' ('Animal Economy'), says, "There are few animals that do not eat flesh in some form or other, while there are many who do not eat vegetables at all; and therefore the difficulty to make the herbivorous eat meat is not so great as to make the carnivorous eat vegetables. Where there is an instinctive principle in an animal, directing it either to the one species of food or the other, the animal will certainly die rather than break through of its own accord that natural law; but it may be made to violate every natural principle by artificial means. That the hawk tribe can be made to feed upon bread I have known these thirty years; for to a tame kite I first gave fat, which it ate very readily, then tallow and butter, and afterwards small balls of bread rolled in fat or butter, and by decreasing the fat gradually it at last ate bread alone, and seemed to thrive as well as when fed with meat. This however produced a difference in the consistence of the excrements; for when it ate meat they were thin, and it had the power of throwing them to some distance; but when it ate bread they became firmer in texture, and dropped like the excrement of a common fowl. Spallanzani attempted in vain to make an eagle eat bread by itself; but by inclosing the bread in meat, so as to deceive the eagle, the bread was swallowed and digested in the stomach."

Mr. Yarrell observes that the œsophagus offers nothing peculiar beyond that of other birds not possessing the power of minutely dividing their food. It is plicated lengthways, allowing great extension, and its separation from the stomach is marked by a zone of gastric rings. The same author notices an opportunity which occurred to him of observing the castings or pellets of some eagles, which had been occasionally fed with dead pigeons. These castings showed that the vegetable food, such as peas, wheat, and barley, which had been swallowed by the eagles in the crops of the pigeons, remained entire, but somewhat enlarged and softened by heat and moisture. In these cases no part of the bones remained.

The intestines of the *Falconidæ* are in general short and large, but Mr. Yarrell remarks that the Osprey is an exception to this rule, and that to the thin membranous stomach of this bird there is attached an intestinal canal measuring 10 feet 8 inches in length, and in some parts scarcely exceeding a crow-quill in size. The canal in most of the species he adds, is in length, compared with that of the bird itself, as three to one; but in the Osprey it is as eight to one; and he observes that in the otter the intestinal canal is very long, equal in size, and without cæcal appendage; the seal too has long intestines with a small cæcum. Mr. Yarrell inquires therefore if it may not be concluded that the small quantity of nutriment which fish, as an article of food, is known to afford renders this extent of canal necessary in order that every portion may be extracted. The cæca of the *Falconidæ* amount to no more than minute rudiments.

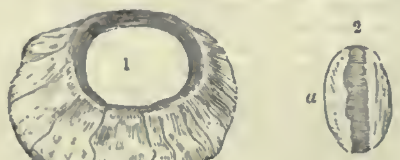
In the organs of respiration there is nothing very remarkable among the *Falconidæ*. The trachea is composed of two membranes inclosing between them numerous bony rings, forming a more or less perfect tube. The rings are strong and compressed. The point of divarication, the cross-bone, and bronchiæ constituting together the inferior larynx, are of the most common form, having but one pair of muscles attached; and the voice though powerful possesses, as might be expected, but little variation. (Yarrell.) *Falco musicus* seems however to be an exception, and it would be desirable to examine its trachea for the purpose of ascertaining whether it is not organised more after the fashion of that of the singing birds.

It might be expected that in the *Falconidæ* the soles of the feet and lower surfaces of the toes which come so closely into contact with the living prey would be endowed somewhat more largely with the sense of touch than those of birds which have no such habits; accordingly we find in the Museum of the College of Surgeons (Physiological Series) a preparation (No. 1400) of one of the feet of an eagle, with the cuticle removed, showing the papillæ and cushions of the cutis on the under surface of the foot.

In the same museum (No. 1482) will be found the tongue, larynx, and lower jaw of the Golden Eagle (*Aquila chrysaëtos*). The tongue is fleshy and large, divided into two lateral portions by a deep longitudinal furrow; at its base is a series of small retroverted spines arranged in the form of a chevron, between which and the larynx the surface is studded with the orifices of numerous glandular follicles: two rows of retroverted spines again occur behind the larynx. There is a row of glandular follicles on either side of the frænum linguæ, and a large cluster of similar orifices immediately anterior to it. The preparations Nos. 1483 and 1484 exhibit respectively the tongue and fauces of an Erne (*Haliæetus albicilla*) and the tongue and larynx of an Osprey (*Pandion haliæetus*).

A longitudinal section of the anterior part of the head of the Golden Eagle will be found in the same museum and series (No. 1538). The preparation shows the turbinated cartilages and cavity of the nose, together with part of the orbit and the air-cell continued from it anteriorly and situated below the nose. The parts are minutely injected, and the vascularity of the pituitary membrane covering the middle turbinated cartilage is well displayed. No. 1539 is a transverse section of the head of an Erne (*Haliæetus albicilla*), showing the convolutions of the middle turbinated cartilages, and the disposition of the pituitary membrane, which is thickest on the convex or mesial side of the convolutions. The air-cells in the superior maxillary bones, and their communications with those which are situated in front of the eyeball, are well seen in this preparation. Bristles have been inserted into the lachrymal ducts, and into the common termination of the Eustachian tubes, the respective conduits of the eye and ear for conducting their superfluous moisture to the nasal passages. An anterior transverse section of the head of the same eagle is shown in No. 1540, which exhibits the external nostrils, the anterior terminations of the middle turbinated cartilages, and of the lachrymal ducts, in which bristles are placed; together with the communications of the maxillary air-cells with the cancellous structure of the upper mandible. ('Cat. Gallery,' vol. iii.)

"The extraordinary powers of vision," says Mr. Yarrell, "which birds are known to exercise beyond any other class of animals are in no genus more conspicuous that in that of *Falco*. Their destination, elevating themselves as they occasionally do into the highest regions, and the power required of perceiving objects at very different distances and in various directions, as well as the rapidity of their flight, seem to render such a provision necessary. The eyes of birds are much larger in proportion than those of quadrupeds, and exhibit also two other peculiarities. The one is the marsupium, a delicate membrane arising at the bottom of the eye, and terminating at or near the edge of the crystalline lens: the other is a ring of thin bony plates enveloped by the sclerotic coat. Comparative anatomists do not seem to be agreed as to the means by which birds obtain their power of vision, whether by an alteration in the form or situation of the crystalline lens, or by both, either or both of which, the greater quantity of aqueous humour which birds are known to possess would seem to facilitate. The existence of muscle attached to the inner surface of the bony hoop of the sclerotica, and inserted by a tendinous ring into the internal surface of the cornea, as shown by Mr. Crampton ('Annals of Philosophy,' 1813), by which the convexity of the cornea may be altered, gives a still greater scope of action, since with two, or at the utmost three, varieties of powers the sphere of distinct vision may be indefinitely extended. Whether the five speices called the True Falcons possess, with their exclusive rapidity of flight, any power of vision beyond their generic companions would be difficult to ascertain; but it may, while on this subject, be worthy of remark that the irides of the gyrfalcon, peregrine, hobby, merlin, and kestrel are hazel-brown, or still darker, while those of all the hawks, buzzards, harriers, and kites are of various shades of yellow. I refer only to adult birds, and do not remember a single exception."



1, bony ring of a Golden Eagle; 2, crystalline lens of the same bird; *a*, the anterior surface, somewhat less convex than the posterior one. (Yarrell.)

Mr. Yarrell observes, that the number of bony plates forming this circle in the Golden Eagle is fifteen; in the White-Tailed Eagle there are but fourteen: and he adds, that the external convex form of the bony ring in the Golden Eagle will be found to extend through all the species of every genus of British birds, except the owls, in all of which it is concave.

In the Museum of the College of Surgeons are the following preparations illustrative of this part of the subject. No. 1741. The head of an eagle, with the eyes in situ. In the left eye the anterior part of the tunics and the humours have been removed to show the retina expanding from the oblique line by which the optic nerve terminates, and the vascular processes of the marsupium extending forwards from the centre of the optic fissure. In the right eye a lateral section of the coats has been removed, together with the humours and a great part of the retina, showing the uniformly dark-coloured choroid, the thin but dense texture of the sclerotica, and the zone of osseous plates which supports the projecting cornea. The marsupium is preserved in situ. It is of an unequal quadrilateral figure, broadest below, and extending upwards and inclined a little backwards, with a slight convexity towards the nasal side of the eyeball. The large size of the eyes is worthy of notice. No. 1742 exhibits a longitudinal section of the eye of an eagle, showing the oblique manner in which the optic nerve perforates the sclerotica and its extended termination, from which the retina expands in a plicated manner: only the folds at its origin are here preserved. The parts being minutely injected, the vascularity of the choroid is shown: also the breadth of the ciliary zone, the breadth and thickness of the bony imbricated hoop surrounding the base of the cornea, the thickness of the cornea itself, and the large size of the anterior chamber of the eye. No. 1743 is the eye of an eagle, with a portion of the coats removed from one side, showing the folds of the marsupial membrane, from which the colouring matter has been removed. In No. 1538, above alluded to, portions of the eye and eyelids with the nictitating membrane are preserved, showing the situation of the two puncta lachrymalia, through which bristles are passed along the ducts to the nose; and in No. 1539, at the back part of the preparation, the left eyeball is laid open, showing the marsupial membrane. The right eyeball is entire, and the abductor, attollens and deprimens oculi, together with the quadratus and pyramidalis muscles of the membrana nictitans, are well displayed. See also No. 1540, as referrible to the organs of vision. No. 1796 exhibits the eyeball, with portions of the horizontal eyelids, the vertical eyelid, or membrana nictitans, of an eagle. The quadratus nictitantis may be observed to have a more extensive origin than in the ostrich, and both muscles of the third eyelid are relatively larger. The cornea is cut away, and the nictitating membrane raised, to show the termination of the duct of the Harderian gland, in which a bristle is placed. Bristles are also placed through the two puncta lachrymalia. The round and slightly concave tarsal cartilage of the lower eyelid may be observed, the upper lid has no tarsal cartilage. In No. 1797 the three eyelids of an eagle are exhibited, and the tarsal cartilage, which is raised as in the act of closing the eyes, is shown.

Aristotle divided the *Falconidæ* into 'Αετοί, or Αἰετοί (Eagles), 'Ιέρακες (Hawks), and 'Ικτῖνοι (Kites), with many subdivisions. Mr. Vigors is of opinion that the division 'Ιέραξ (Hierax) of Aristotle comprises all the *Falconidæ* of Vigors which belong to the stirpes or sub-families of Hawks, Falcons, and Buzzards. Pliny separates the group into *Aquilæ* (Eagles) and *Accipitres*, a general term comprising, as used by him, the rest of the *Falconidæ*. The subdivisions of both Aristotle and Pliny do not differ much from the subdivisions of some of the modern zoologists.

Belon, beginning with the Vultures, proceeds from them to the Eagles; thence to the Gerfault, which he gives as the Morphnos, Morphna, Nittophonos, Plangos, Plancus, Plangus, and Clangus, of the Greeks, and *Anataria* of the Latins; next he places the Orfraye, which he makes the *Haliæetus* of the Greeks, the Aguista Piombina of the modern Italians, and gives *Aquila marina* as the Latin name. He then treats of the *Ossifragus* as the Phinis of the Greeks, *Aquila barbata* in Latin, recording it provisionally as a species of Vulture (Petit Vautour) and next describes the Buzzard (Buse ou Busard) as a kind of Bastard Eagle, and as the Gypaëtos, Percnopterus, or Oripelargus, of the Greeks. Then comes the Goiran, or Boudree, which he describes as living upon rats, mice, frogs, lizzards, &c., caterpillars, and sometimes slugs and serpents, asserting that it becomes very fat, and that it is taken frequently in winter for the sake of its flesh, which is good for food. This he supposes to be the *Hierax*, called Phrynolochos by the Greeks, and gives *Rubetarius Accipiter* as the Latin name. Jean le Blanc, or Oyseau Saint Martin, which he considers to be the Pygargus of the Greeks, follows, and is succeeded by another Oyseau Saint Martin, or Blanche-Queue. Belon then gives an account of the Birds of Prey employed in falconry. The Sacre and her Sacret, the Autour and her Tiercelet, the Fau-Perdrieux (Circus?), and the Falcons generally, with their Tiercelets. He then describes the Hobreau (Hobby?), the Esmerillon (Merlin?), the Espervier (Sparrowhawk?), the Lanier and Laneret, and the Cresserelle (Kestrel?). Next follow the Butcher-Birds, then come the Kites (Milan Royal, Milan Noir—Milvus), and (the Cuckoo intervening from a supposed similitude to the Birds of Prey) the Owls.

Passing by Gesner, Aldrovandus, and Jonston, we pause to notice Willughby's arrangement. He separates the carnivorous and rapacious birds, called Birds of Prey, into the Diurnal (those that prey in the day-time) and the Nocturnal (those that fly and prey by night). The following is his table of the Diurnal section:—

Diurnal	The Greater, and these either . . .	The more generous, called Eagles: the Golden Eagle, the Sea-Eagle, the Black Eagle, &c.		
		The more cowardly and sluggish, called Vultures.		
	The Lesser, called in Latin *Accipitres*	The more generous, that are wont to be reclaimed and manned for fowling, called Hawks, which our falconers distinguish into	Long-Winged, whose wings reach almost as far as the end of their train, as the Falcon, Lanner, &c.	
			Short-Winged, whose wings when closed fall much short of the end of their trains, as the Goshawk and Sparrowhawk.	
		The more cowardly and sluggish, or else indocile, and therefore by our falconers neglected, and permitted to live at large .	The Greater.—The Common Buzzard, Bald Buzzard, &c.	
			The Lesser	European: Butcher Birds or Shrikes.
				Exotic: Birds of Paradise.

Ray, in his 'Synopsis,' follows Willughby, and both Ray and Willughby place the Cuckoo after their Diurnal Birds of Prey and immediately before the Nocturnal.

Brisson's third order consists of birds with a short and crooked beak, and the first section contains the genera Epervier (Hawk), Aigle (Eagle), and Vautour (Vulture).

Linnæus makes his first order, *Accipitres*, consist of the genera *Vultur*, *Falco*, *Strix*, and *Lanius*. The genus *Falco* contains the elements of the different branches of the family of *Falconidæ*.

Without entering into the methods of Buffon, Schæffer, and Scopoli, we proceed to that of Latham, who made the *Accipitres* his first order of Terrestrial Birds, containing the genera Vulture, Falcon, and Owl.

Pennant makes the Rapacious Birds (his first section) consist of two genera only, namely, Falcon and Owl.

M. de Lacépède placed the Birds of Prey (his seventh order) at the head of his second division of birds. His genera are *Vultur*, *Gypaëtos* (Griffon), *Aquila*, *Astur*, *Nisus*, *Buteo*, *Circus*, *Milvus*, *Falco*, and *Strix* (Owl).

M. Duméril divided his first order, *Rapaces*, into three families: the first Nudicolles, or Ptilodères, consisting of the genera *Sarcoramphus* and *Vultur*; the second Plumicolles, or Cruphodères, containing the genera Griffon, Messager, Aigle, Buse, Autour, and Faucon; and the third the Nocturnes or Nycterins (Owls).

Blumenbach's first order, *Accipitres* (Birds of Prey, with strong hooked bills and large curved talons, a membranous stomach, and short cæca) consists of the genera *Vultur*, *Falco*, *Strix*, and *Lanius*.

Meyer's first order, *Rapaces*, is divided into two sub-orders: first, the *Scleropteræ*, or Diurnal Birds of Prey; second, the *Malacopteræ*, or Nocturnal Birds of Prey.

The third order of Illiger, *Raptatores*, is composed of the *Nocturni* (*Strix*), the *Accipitrini* (*Falco*, *Gypogeranus*, *Gypaëtus*), and the *Vulturini* (*Vultur*, *Cathartes*).

Cuvier divides his first order (the Birds of Prey) into Diurnal and Nocturnal. The first are subdivided into the Vultures and the Falcons (*Falco*, Linn.), which last are separated into the Noble Birds of Prey, or Falcons properly so called (*Falco* of Bechstein), comprising the genera Faucon (*Falco*) and the Gerfaults (Gyr-Falcons, *Hierofalco* of Cuvier); and the Ignoble Birds of Prey, consisting of the Eagles (*Aquila* of Brisson), which are subdivided into the Eagles properly so called (*Aquila* of Cuvier), the Aigles-Pêcheurs (Fishing Eagles, with comparatively long wings, *Haliæetus* of Savigny), the Balbusards (*Pandion* of Savigny), the Circaëtes (*Circaetus*, Vieillot, Jean le Blanc, &c.), the Caracaras (*Polyborus*, Vieillot, and *Ibycter*, Vieillot), and the Harpies, or Fishing Eagles, with short wings (*Harpyia* of Cuvier); the tribe *Cymindis* of Cuvier; the Aigles-Autours (*Morphnus* of Cuvier, Spizaëtos of Vieillot); the Autours (*Astur* of Bechstein, *Dædalion* of Savigny); the Milans (*Milvus* of Bechstein, *Elanus* of Savigny); the Bondrées (*Pernis* of Cuvier, Honey Buzzard); the Buses (*Buteo* of Bechstein); the Busards (*Circus* of Bechstein); and the Messager or Secrétaire (*Serpentarius* of Cuvier, *Gypogeranus* of Illiger).

Vieillot divides his first order, *Accipitres*, into the Diurnal and Nocturnal tribes, making the first tribe to consist of three families:—1st, Vautourins, among which he places the *Caracara*; 2nd, Gypaëtes; 3rd, Accipitrins, consisting of the genera Aigle, Pygargue, Balbuzard, Circaëte, Busard, Buse, Milan, Elanus, Ictinie, Faucon, Physète, Harpie, Spizaëte, Asturine, and Epervier.

Temminck's first order, *Rapaces*, comprises the genera Vautour, Catharte, Gypaëte, Messager, Faucon, and Chouette.

Mr. Vigors thus arranges the *Falconidæ*:—

	TYPICAL GROUPS.	
Beaks short, strongly toothed. Prey aërial.	Wings short.	Sub-Family, *Accipitrina*. Hawks.
	Wings long.	Sub-Family, *Falconina*. Falcons.
	ABERRANT GROUPS.	
Beaks long, or subloug, not toothed. Prey terrestrial	Beaks hooked (adunca) from the base. Wings long.	Sub-Family, *Buteonina*. Buzzards.
	Beaks hooked from the base. Tail forked. Wings very long.	Sub-Family, *Milvina*. Kites.
	Beaks hooked at the apex only * Long-Winged. * * Short-Winged.	Sub-Family, *Aquilina*. Eagles.

De Blainville divides the *Raptatores* into the Diurnal and the Nocturnal. The former he divides into the Anomalous (the Secretary, *Serpentarius*); and the Normal (*Falco*, Linn.).

M. Latreille separates his first order of terrestrial birds (*Rapaces*) into two tribes—the Diurnal and the Nocturnal. The first contains two families:—1st, the Vautourins (Vultures); 2nd, the Accipitrins. The latter consists of the genera Aigle, Pygargue, Balbuzard, Harpie, Aigle-Autour, Asturine, Messager, Autour, Epervier, Elane, Milan, Bondrée, Busard, Faucon, Gerfault.

Prince C. L. Bonaparte, in his 'Tabella Analitica,' divides his 'Ordine *Accipitres*' into the 'Famiglia *Vulturini*,' and the 'Famiglia *Rapaces*.' These last he separates into the *Diurni*, with eyes on the sides of the head, "Occhi nei Lati;" and the *Nocturni*, with eyes in the face, "Occhi sulla Faccia." His Diurnal rapacious birds consist of two genera, namely, *Gypaëtos* and *Falco*. The latter comprises the following sub-genera:—*Aquila*, *Haliaëtos*, *Pandion*, *Falco*, *Astur*, *Milvus*, *Elanus*, *Buteo*, *Circus*.

M. Lesson, in common with other zoologists, separates his first order, the Birds of Prey, *Accipitres* or *Rapaces*, into the Diurnal and Nocturnal. The first embraces three families:—1st, the Vultures; 2nd, the Falcons, or *Falconidæ*, which he subdivides into the Noble Birds of Prey, namely the genera *Falco*, *Hiero-Falco*, *Physeta*, and *Gampsonyx*; and the Ignoble Birds of Prey, namely the genera *Aquila*, *Haliæetus*, *Pandion*, *Circaëtus*, *Caracara*, *Harpya*, *Morphnus*, *Cymindis*, *Astur*, *Nisus*, *Milvus*, *Ictinia*, *Elanus*, *Nauclerus*, *Pernis*, *Buteo*, *Circus*. 3rd, the Messagers, or *Serpentarii*, consisting of one genus only, *Serpentarius*, the Secretary Falcon.

Mr. Swainson ('Fauna Boreali-Americana') remarks that in contemplating the Diurnal Birds of Prey, arranged by Linnæus under the genus *Falco*, we can be at no loss to discover the two typical forms in the Toothed-Billed Falcons and the Sparrowhawks. Their peculiarities, he adds, did not escape the notice oven of the earliest systematic writers; and the moderns, he observes, have only confirmed the justness of the distinction. But with regard to the remaining groups he states that much diversity of opinion still exists; not indeed as regards the leading divisions, for here likewise the ancients had long ago anticipated our distinctions between the Eagles, Kites, and Buzzards. It is not therefore to these groups, taken per se, that any doubts can attach on their respective peculiarities, but rather as to their relative rank with those that are considered typical. These doubts, in Mr. Swainson's opinion, can only be solved by analysis; and from an attentive consideration of the difficulties arising from the want of materials in our museums, and other causes, he has been induced to dissent from several modern writers upon this family. He admits that it has been sufficiently proved that the various forms of which it is composed exhibit, as a whole, a circular succession of affinities; but the true series of the secondary groups among themselves has not, he asserts, yet been made out: he adds however that the inability to state in what way the falcons or hawks form their own respective circles cannot militate against the belief that such is their true distribution. "It remains therefore," continues Mr. Swainson, "to be considered whether there is presumptive evidence to believe that the three remaining divisions, namely, the Buzzards, Kites, and Eagles, form one circular group independent of their affinity to the two former. The true Buzzards, of which the *Vulgaris* and the *Lagopus* may probably be types, are slender long-winged birds; the bill is small, short, and considerably curved: in this structure they agree with the true falcons, yet they are well known to be distinguished from them by wanting the toothed-bill, and by the shortness and graduated abbreviation of the exterior quill-feathers. Now, if nature had proceeded in a simple course from the buzzards to the falcons, we should have had birds uniting the distinctions of both variously modified. Both these groups being composed in their typical examples of slender long-winged birds with short bills, any species exhibiting the reverse of such characters, and intervening between the two forms, would certainly appear anomalous, on the supposition of a simple series of affinities being aimed at. Yet that such birds are to be found even among the few that we are subsequently to notice is unquestionable. Let us then take the *Buteo borealis*, which as being more allied to the falcons than to the kites may be considered an intervening form between the *Buteo vulgaris* and *Falco*. We here see a large-sized heavy bird with shortened wings not reaching to more than half the length of the tail, while the elongated bill, unlike either that of *Buteo* or *Falco*, obviously assimilates to that lengthened form which belongs to the eagles. Now upon the supposition that a bird so constructed is intended to fill up the interval between *Buteo* and *Falco*, and at the same time to unite the former with the eagles, the singularity of its structure is no longer surprising; but if we consider it with a simple reference to the passage between *Buteo* and *Falco*, we are almost tempted to suspect that in this instance a real saltus has been made." While upon this subject we may cite an acute observation made by Prince C. L. Bonaparte, that "the *Borealis* is almost as much an *Astur* of the first section as a *Buteo*;" a proof at least that its affinities to *Astur* and to the aberrant eagles adjoining that group have not escaped observation. Our idea that the buzzards are truly united to the eagles is still further strengthened by the *Buteo pterocles*, Temm. ***. In this species the wings, as in *Buteo*, are remarkably long; but the bill is so considerably lengthened, that were we to judge alone from this member we should have no scruple in placing the bird among the *Aquilæ*. On the other hand, it must be remembered that as every group, from the highest to the lowest denomination, when perfect, contains a representation of the other four, united to a form peculiar to itself, so we might naturally expect that one division of the buzzards would represent the true eagles. To ascertain therefore whether the resemblances above stated are those of analogy or of real affinity, recourse must be had to strict analysis. Now this in our present state of knowledge cannot be done, at least from the resources to be found in this country. We have thought it advisable to cite the above facts, drawn from the structure of the birds themselves, as likely to awaken the attention of ornithologists to a further investigation of the subject; they will at least show that our opinion on the unity of the three aberrant groups is not entirely without foundation. Mr. Swainson considers the relative value of the whole group equivalent to that of *Vultur* or *Strix* in its own order, and to the families composing the *Rasores*, *Grallatores*, and *Natatores*, and he contemplates the five principal divisions as genera, arranging the subordinate forms as sub-genera; but in considering the five forms of the *Falconidæ* as genera rather than sub-families, he guards himself against the supposition that he may mean to insinuate that the minor distinctions which have been dwelt upon by several able ornithologists who have investigated this family are either trivial or that they deserve not to be brought immediately before us. On the contrary, he recommends to others the plan adopted by himself, namely, the minute examination of every change of structure, and the assembling together in minor groups such species as agree in certain peculiarities. Further, he would proceed in certain cases even to impose a name upon such groups, but in a family already so crowded by generic names he considers it essential to preserve a distinction between groups of unequal value; and not to elevate sub-genera, or forms of transition, to a rank they do not hold. *Milvago*, *Polyborus*, *Daptrius*, and *Ibycter* are unquestionably, in his opinion, of the latter description, each confined but to one species;

and he says that he has another of the same natural group in his cabinet, equally deserving a patronymic name. By regarding these as genera, each as he thinks is made equivalent to the whole genus of typical falcons; whereas, by representing them as lesser variations, which he considers them in truth to be, the student immediately perceives that their station is subordinate.

The genera into which Mr. Swainson ('Natural History and Classification of Birds,' 1836) divides the *Falconidæ* are *Falco*, *Accipiter*, *Buteo*, *Cymindis*, and *Aquila;* and he gives the following table as the concentration of his remarks in reference to the sub-genera of *Falco*:—

Sub-genera of *Falco*.		Genera of the *Falconidæ*.
	1. Typical Group.	
Falco.	Pre-eminently typical; bill acutely toothed; wings pointed, rather long.	*Falco.*
	2. Sub-Typical Group.	
Harpagus.	Wings shorter, rounded; tarsi with entire transverse scales.	*Accipiter.*
	3. Aberrant Group.	
Lophotes.	Feet short; head crested.	*Aquila.*
Aviceda.	Feet small, very short; soles broad and flattened; outer toe and claw shortest.	*Cymindis.*
Gampsonyx.	Bill neither notched or (nor) festooned; head small; feet strong.	*Buteo.*

By throwing each of these columns into their respective circles, and then bringing them into juxtaposition (which he does in the work quoted), the same results, he remarks, will follow. Into the Accipitrine circle he admits *Ictinia* provisionally, *Accipiter* (type), *Astur* (Goshawks), *Haliæetus* (*H. Pondicerianus*), and no more. In the Aquiline circle he retains four 'types,' namely, *Pandion*, *Harpyia*, *Aquila*, and *Ibycter*. In the Cymindian or Milvine circle he places *Polyborus*, *Cymindis*, *Elanus*, *Nauclerus*, and *Circætus*, the last with a query, and in the cut of the circle it is not mentioned. In the Buteonine circle *Milvus*, *Circus*, and *Buteo*.

Mr. Vigors, who as we have seen first proposed the application of the Quinary System to the *Falconidæ*, and indeed to the birds in general, thus defines the family which is the subject of our inquiry, and thus follows out his arrangement:—

Falconidæ. (Leach.)

Head plumose. Beak strong, hooked, with a cere at the base. Nostrils lateral, more or less rounded, open and situated in the cere. External toes especially connected with the middle toes. Claws or nails strong, very sharp, very much incurved, and retractile.

1st Sub-Family, *Aquilina.*

Beak long, hooked at the apex only. Fourth quill the longest.

* Long-Winged Eagles.

Ibycter (Vieillot).—Beak convex above; lower mandible notched at the apex, and subacute; cere naked; cheeks, throat (gula), and crop (jugulum), featherless; claws acute.

Mr. Vigors remarks that the type of this genus is *Falco aquilinus* of Gmelin, Petit Aigle d'Amerique of Buffon, and that he believes it still stands single in the genus.—Beak cærulean; cere and feet yellow; orbits yellow; irides orange; body, above, cærulean; below, red going into white; neck purplish to rufous; claws black. Gmelin gives it as the Red-Throated Falcon of Latham. It is a native of South America.

Daptrius (Vieillot).—Beak convex above; lower mandible angular beneath, notched at the apex, obtuse; cere with scattered hairs; orbits, throat, and crop, featherless; claws acute.

"How far," writes Mr. Vigors, "the two preceding genera of M. Vieillot are sufficiently distinct from each other, or from the remainder of the Naked-Cheeked Eagles, it is not for me to hazard an opinion, without the opportunity of more accurate examination of the birds than is at present within our power, and a more accurate knowledge of them than a mere description affords us. It would appear however that one group at least, that of *Ibycter*, is sufficiently distinguished from the other *Falconidæ* with the naked cheeks, by the difference of its food and habits. The accounts which have reached Europe of its mild and gentle manners and vegetable food, have even induced some naturalists to refer it to the Gallinaceous Birds. I have strong doubts indeed whether the birds that compose this genus may not belong to quite a distinct station from the present, and be referrible to one of those groups which I have elsewhere observed to be wanting among the Birds of Prey, to perfect that chain of affinities which is to be found complete in all the other orders. It is impossible however at present to come to any decision on the subject. While our materials for classification are so scanty, the most that is in our power is to conjecture the place which more perfect information will enable us to assign any group hereafter. For the present we

Head and foot of Red-Throated Falcon (*Ibycter aquilinus*).

may leave the genus before us in that situation, between the *Vulturidæ* and the *Falconidæ*, which they have hitherto been generally supposed to fill."

D. ater, the Iribin Noir of Vieillot, and the Caracara Noir, *Falco aterrimus*, of Temminck. Black with bluish reflections; tail white at its base above, and rounded; beak and claws black; cere blackish-ash, space round the eyes naked and of a flesh-colour; feet yellow Length from 14 to 15 inches French.

It is a native of Brazil and Guyana.

Head and foot of *Daptrius ater*.

Polyborus (Vieillot).—Beak compressed above; lower mandible entire and obtuse; cere covered with hairs, large; cheeks and throat featherless; crop woolly.

P. Brasiliensis (*P. vulgaris*, Vieillot), the Brazilian Caracara Eagle. We select Mr. Bennett's description and general history of this species as the most complete. After giving the generic characters, and observing that the wings nearly equal the tail in length, that they are of a rounded form with the third and fourth quills longest; that the legs are rather long, naked, and reticulated, and the claws of moderate length and curvature, but with little acuteness or power of grasping, the last-named author thus proceeds:—"In the Brazilian Caracara the whole upper surface of the head is black, with the feathers slightly elongated backwards, and capable of being partially elevated in the shape of a pointed crest. The entire neck is of a light brownish-gray, which also forms the ground colour on the breast and shoulders, but with the addition on these parts of numerous transverse wavy bars of a deeper brown. Nearly all the rest of the plumage is of a tolerably uniform shade of blackish-brown, with the exception of the tail, which is at the base of a dirty white, with numerous narrow transverse undulated bands of a dusky hue, and, in its terminal third, black without any appearance of banding. The beak is horn-coloured at the tip and bluish at the base; the iris hazel; the cere and naked cheeks of a dull red; the legs yellow, and the claws black. Such at least are the colours of the living specimen in the Society's garden. Several changes however take place in the plumage of the bird as it advances in age, and these are well illustrated by an extensive series of specimens in the Museum in Bruton-street,"—now in the Gardens, Regent's Park. "So great in fact is the variation of colours in this species that scarcely any two descriptions of it correspond throughout, and the figures by which it has been illustrated differ from each other even more remarkably than the descriptions by which they are accompanied." ('Gardens and Menagerie of the Zoological Society.')

Head and foot of the Brazilian Caracara Eagle (*Polyborus Brasiliensis*).

The same author observes that Marcgrave was the first to introduce into Europe the name of Caracara, the vulgar appellation of the bird in Brazil, derived from its hoarse and peculiar cry. But although M. Cuvier regards Marcgrave's Caracara as identical with the species described by Mr. Bennett, the latter remarks that both the figure and description are so much at variance with it that he feels himself compelled to adopt in preference the opinion of Professor Lichtenstein, founded upon the original drawing, that they belong to a totally different bird. Mr. Bennett is consequently unable to trace the history of the true Caracara beyond the year 1784, when a figure and description were published at Vienna by the younger Jacquin, from his father's papers, under the name of *Falco Cheriway*. These Mr. Bennett has no hesitation in referring to the present species. The principal differences between them consist, he states, in the markings on the breast and neck, which in the figure are more longitudinal than transverse; and in the very awkward foreshortening of the beak, which completely distorts its natural form. The former appears, from the specimens in the Society's Museum, to be one of the distinctive marks of the young bird. Cuvier, in the last edition of the 'Règne Animal,' observes that the *Falco Cheriway* of Jacquin may be nothing but a variety of age. Mr. Bennett then notices the very complete description of the adult Caracara in D'Azara. According to this author, the full-grown bird measures 21½ inches in length and 50 in the expanse of the wings. Its colours agree with the description above given, excepting that the first six quill-feathers of the wings are white, marked with rays and spots of brown, and become blackish towards the point; the back is transversely rayed with brown and white, the latter predominating on its upper half, and vice versâ; the fore part of the neck and breast are traversed by dusky lines mixed with a larger proportion of white; the cere is of an orange hue; and the throat and sides of the head are almost white. This description, Mr. Bennett remarks, very nearly coincides with that of M. Cuvier, taken from specimens in the Paris Museum, and with the figure of one of these specimens given by M. Vieillot in his 'Galerie des Oiseaux;' and Mr. Bennett then refers to the figure given by M. Spix in his 'Birds of Brazil,' as the young of this species, which resembles M. Vieillot's in its form, except that the legs are longer and thicker, and the tips of the wings reach to the extremity of the tail. In colour it is rather of a darker brown, approaching more nearly to the Society's specimen alluded to by Mr. Bennett; the throat is light brown instead of white; and the transverse waves of the breast and shoulders are replaced by longitudinal brown dashes upon a light ground. The cere and naked cheeks are in both of a bright yellow; indeed Mr. Bennett states that he has nowhere met with them of the same hue with those of the Society's living specimen, except in the figure and description of Jacquin.

The Caracara is said to live either alone or in pairs. But D'Azara states that he has seen them join in companies of four or five to hunt down prey which a single Caracara would find a difficulty in mastering, such as red buzzards, herons, and other large birds; and it is believed that they will even destroy the American ostrich, young fawns, and lambs, when so associated. In its food it seems to be content with any animal substance. Carrion (for if a Caracara see a vulture devour a piece of flesh he is said to pursue him and compel him to disgorge it), toads, frogs, worms, snails, lizards, grubs, grasshoppers, winged-ants, snakes, and flies, birds—in short the general prey of buzzards, hawks, falcons, and insectivorous birds—all suit its appetite. Two of the specimens obtained by M. Spix were shot in the act of extracting insects from the hides of oxen. D'Azara will not allow that the Caracara preys on the smaller birds, because, he says, that it is unable to catch them; but Prince Maximilian found in the stomachs of those which he opened the remains of small birds and insects, especially grasshoppers, which abound in its haunts. It is by no means shy, and advances like the vultures to inhabited places, perching on trees and house-tops and not caring to conceal itself. It is seldom attacked, for it rarely molests domestic poultry, but it is stated that it will sometimes carry off the sportsman's game. The nest, according to D'Azara, is built on the tops of trees, especially those round which the climbing plants are most luxuriant, or in a bushy thicket. It is large, and composed of sticks and twining branches laid nearly flat, and lined, inartificially, thickly with hairs. The eggs, which are laid in August, September, or October, are two in number, pointed at one end, and dotted and blotched with crimson on a brownish-red ground.

This bird extends over a considerable part of South America; the island of Aruba, on the coast of Venezuela (Jacquin); Brazil and Paraguay (Cuvier); most abundant in the south and east of Brazil (Prince of Neuwied); Spix's specimens were from the northern provinces; less numerous on the Rio de la Plata than in Paraguay, where it is almost equal in number to all the other birds of prey put together (D'Azara); Straits of Magalhaens (Captain Phillip Parker King, R.N.).

Mr. Bennett's provisional species *Polyborus* (?) (*hypoleucus*) was founded on the Angola Vulture of Pennant, *Vultur Angolensis* of Gmelin, in an immature state of plumage.

Dr. Smith proposed the genus *Polyboroides* for the *Falco Gymnogenys* of Temminck in the South African Journal, in April, 1830, and M. Lesson, in the November of that year, separated the same form under the generic title *Gymnogenys*.

From *Ibycter* and *Polyborus* Mr. Vigors passes to the Fishing Eagles, and particularises as the first

Pandion (Savigny).—Beak rounded above; cere hispid; nostrils lunulated and membranaceous on the upper margin; tarsi naked; acrotarsia covered with rigid reticulated scales; toes free, the external toes versatile; claws equal, rounded underneath; second quill longest.

P. Haliæetus, the Bald Buzzard, Osprey, or Fishing Eagle; the Fishing-Hawk and Fish-Hawk of the Americans; Aquila Pescatrice of the Italians; *Haliætus* and *Morphnos* of Aldrovandus; *Balbusardus Anglorum* of Ray; and *Falco Haliætus* of Linnæus. This bird appears to be widely diffused. Temminck observes, that it is generally distributed through Europe, and that it abounds in Russia, Germany, and Switzerland. It is also found in Egypt. In the British Islands it seems to be comparatively rare. Willughby records one that was shot at Penzance with a mullet in its claws; and White mentions another that was shot at Frinsham Pond, near Selbourne, while it was sitting on the handle of a plough and devouring fish. "It used," says White, "to precipitate itself into the water and take its prey by surprise."

Bald Buzzard (*Pandion Haliaetus*).

It has been seen at Killarney in Ireland; and Montagu speaks of its frequent occurence in Devonshire. Selby says, "I have seen them upon Loch Lomond, where they are said to breed: but they are far from being numerous in Scotland." Montagu corroborates this; for he says, in his 'Ornithological Dictionary,' "It is said to make its nest generally on the ground by the side of water, composed of flags and rushes; but we once saw the nest of this bird on the top of a chimney of a ruin in an island on Loch Lomond in Scotland; it was large and flat, formed of sticks laid across, and resting on the sides of the chimney, lined with flags."

Prince C. L. Bonaparte states that it is found near Rome.

In America it is said to be found in the summer from Labrador to Florida; and it is even stated to have been seen in Cayenne: indeed Latham gives it the name of Cayenne Osprey. But it is in the more temperate climate of the new continent that the bird abounds; and there its coming is eagerly watched by the fishermen as the harbinger of the shoals of fish that approach the shores in the spring.

"Towards the close of March," writes Nuttall in his interesting 'Manual,' "or beginning of April, they arrive in the vicinity of Boston with the first shoal of alewives or herrings, but yet are seldom known to breed along the coasts of Massachusetts." The same author attributes their departure from New York and New Jersey, as early as the close of September, or at farthest the middle of October, when they migrate farther south, to the going of the fish on which they are accustomed to feed; for they principally live on fish, which they take by dashing from on high into the water with such violence, that, as Pennant observe, the Italians have applied to the bird the epithet 'piombina.'

But the Bald Buzzard is haunted by a persecutor that often snatches from it the hard-earned prey. Catesby and others describe its sufferings from the piracy of the White-Headed Sea-Eagle, *Haliæetus leucocephalus;* and Wilson gives the following vivid description of such a scene—a description which those only who have devoted themselves to watching the habits of animals can give:—"Elevated," says that admirable ornithologist, speaking of the White-Headed Eagle, as he saw him in America, "on the high dead limb of some gigantic tree that commands a wide view of the ocean, he seems calmly to contemplate the motions of the various feathered tribes that pursue their busy avocations below, the snow-white gulls slowly winnowing the air; the busy tringæ coursing along the sands; trains of ducks streaming over the surface; silent and watchful cranes, intent and wading; clamorous crows, and all the winged multitudes that subsist by the bounty of this vast liquid magazine of nature. High over all these hovers one whose action instantly arrests his attention. By his wide curvature of wing, and sudden suspension in the air, he knows him to be the fish-hawk, settling over some devoted victim of the deep. His eye kindles at the sight, and balancing himself with half-opened wings on the branch, he watches the result. Down, rapid as an arrow from heaven descends the distant object of his attention, the roar of its wings reaching the ear as it disappears in the deep, making the surges foam around. At this moment the eager looks of the eagle are all ardour; and levelling his neck for flight, he sees the fish-hawk once more emerge struggling with his prey, and mounting in the air with screams of exultation. These are the signals for our hero, who, launching into the air, instantly gives chace, and soon gains on the fish-hawk. Each exerts his utmost to mount above the other, displaying in these rencontres the most elegant and sublime aërial evolutions. The unincumbered eagle rapidly advances, and is just on the point of reaching his opponent, when with a sudden scream, probably of despair and honest execration, the latter drops his fish; the eagle, poising himself for a moment, as if to take a more certain aim, descends like a whirlwind, snatches it in his grasp ere it reaches the water, and bears his ill-gotten booty silently away to the woods."

The Bald Buzzard is a powerful bird, and the females, which are the largest, as indeed they are among most of the birds of prey, sometimes weigh 5 lbs. The plumage, which is very like that of the water-fowl, and adapted to resisting the fluid into which it plunges for its prey, is white below, with a few brown streaks and speckles on the throat. There is indeed a patch of brown on the upper part of the breast in young birds. The crown of the head is light-brown, edged with white; and there is a streak of dark-brown from the eye to the shoulders. The whole of the upper part of the body is brown. The feathers on the thighs are close, and the legs short, stout, and grayish: and in this part of its organisation we see a beautiful instance of adaptation to its habits. The close thigh-feathers resist the action of the water, while the talon of the outer toe is much larger than the inner one, and capable of being turned backwards; the under surfaces of all the toes are also very rough and covered with protuberances, which enable it to secure its slippery prey. The irides are of a lemon colour.

Head and foot of Bald Buzzard (*Pandion Haliæetus*).

The Bald Buzzard, or Osprey, lays from two to four eggs, a little larger than those of the common fowl, of a reddish or yellowish cream-colour, marked with blotches and dots of reddish-brown. During incubation the male often feeds the female. Nuttal, in his 'Manual,' gives the following account of their habits in the breeding season:—

"Unlike other rapacious birds, the ospreys may be almost considered gregarious, breeding so near each other, that, according to Mr. Gardiner, there were on the small island on which he resided, near to the eastern extremity of Long Island, New York, no less than 300 nests with young. Wilson observed twenty of their nests within half a mile. I have seen them nearly as thick about Rehoboth Bay, in Delaware. Here they live together at least as peaceably as rooks; and so harmless are they considered by other birds, that, according to

Wilson, the crow blackbirds, or grakles, are sometimes allowed refuge by the ospreys, and construct their nests in the very interstices of their eyry. It would appear sometimes, that, as with swallows, a general assistance is given in the constructing of a new nest; for, previous to this event, a flock have been seen to assemble in the same tree, squealing, as is their custom, when anything materially agitates them."

Mr. Vigors is of opinion that this group presents us with a decidedly characteristic difference from all the other species of the family, except those of *Elanus*, in the internal parts of the nails being rouuded instead of grooved. The culmen of the bill, he observes, is also broader than usual, and much rounded; the toes are entirely separated, and the tarsi are covered with strong, prominent, and thickly reticulated scales. The same author remarks that the Osprey (*Falco Haliæetus* of Linnæus) is the type of the genus to which the valuable researches of Dr. Horsfield iu Java have added a second species, *P. Ichthyætus*. In this species however, which agrees with *Pandion* in the more essential characters, Mr. Vigors finds a strong approximation to the following genus, *Haliæetus*. Its bill, he adds, is more compressed than that of *Pandion*, its acrotarsia are scutellated, and the 4th quill-feather, as iu *Haliæetus*, is the longest. It thus stands, in the opinion of Mr. Vigors, osculant between the two groups.

The last group of the Fishing Eagles, according to Mr. Vigors, is comprised in the next genus,

Haliæetus (Savigny).—Beak convex above; nostrils lunnlated, transverse; cere subhispid; tarsi semiplumed; acrotarsia scutellated. Toes free, tho external toe versatile; claws unequal.

Mr. Vigors notices the difference of this form from *Pandion* in the structure of the nails, and the more compressed culmen of the bill; in the tarsi also, which have the acrotarsia scutellated, and are feathered half way below the knee. Thero are several species; for instance, *Falco leucocephalus*, *F. albicilla*, *F. Pondicerianus*, *F. blagrus*, *F. vocifer*, &c. &c.

H. leucocephalus, the Sea-Eagle, Bald Eagle, White-Headed Eagle—the symbol of the United States of America.

Head and foot of the Sea-Eagle (*Haliæetus leucocephalus*).

Before we proceed to the descriptiou of our example, it may be necessary, with Mr. Bennett's assistance, to clear up the confusion which, as he observes, has existed in the synonymy of *Haliæetus albicilla*, the difference of the colours of tho plumage in the various stages of its growth having induced authors to record it under several distinct names. Three of these were almost universally admitted till about twenty-six years ago, when the result of F. Cuvier's observations on the individuals kept in the Jardin des Plantes led him to unite *Falco ossifragus*, *F. albicaudus*, and *F. albicilla* of Gmelin under one name: subsequent inquiry has confirmed this conolusion. In the earlier stages of life, the beak of *H. albicilla* is of a bluish horn-colour; its head and neck deep brown; the plumage above, brownish-black mixed with whitish or ash-coloured spots on the back and tail. In this state it is *Falco ossifragus* of systematists. About the third or fourth year the head and neck become ashy-brown; the beak gradually changes from bluish to pale-yellow, the white spots on the back vanish, aud the tail becomes uniformly grayish-white. It is now *Falco albicaudus* of Gmelin, Petit Pygargue of Buffon, and the Lesser White-Tailed Eagle of Latham. In its fifth year it is come to maturity, and the change is complete. The head and neck have little of the brown tinge left, the back is throughout of a dusky-brown intermingled with ashy-gray, and the tail is quite white. In this its perfect state it is *Falco albicilla*, the Grande Pygargue, tho White-Tailed or Cinereous Eagle. In all the stages of this the Great Sea-Eagle which inhabits nearly the whole of Europe and of Northern Asia, the cere and naked parts of the legs are yellow; the under part of tho body is of a lighter hue than the upper, and more thickly interspersed with pale ciuereous spots; the claws are completely black. ('Gardens and Menagerie of the Zool. Soc.')

Mr. Bennett, in the work last quoted, remarks, that in the earlier stages of its growth there is littlo to distinguish this species from the Great Sea-Eagle. M. Vieillot indeed, following the example of Daudin, has united the White-Headed Eagle to the list of synonyms of the Great Sea-Eagle. "That such a uuion," writes Mr. Bennett, "is fouuded upon insufficient data is proved by the gradual development in the bird under consideration of a character which, after a certain age, at once distinguishes it from the remainder of its tribe. This character consists in the pure whiteuess of its head and neck, from whence it has derived the popular but inappropriate title of tho Bald Eagle, by which it is most commonly known." The young are clothed at first with a thick whitish or cream-coloured cotton-liko down, aud they become gradually gray as the development of the true plumage goes on. In the third year the white may be traced upon the head, ueck, tail-coverts, and tail; and by the end of the fourth year these parts become completely white, or sometimes tinged slightly with cream-colour. The eye, which is at first hazel, changes to a brilliant straw-colour as the head whitens. (Wilson.) "This account of the metamorphoses in colour of the White-Headed Sea-Eagle," says Mr. Bennett, "derived from the personal observations of the accurato author of the 'American Ornithology,' has been in a great measure verified under our own inspection in the specimen now before us, which remained for several years in the possession of Mr. Brookes, before it was presented by him to the Society.

"During a considerable part of the time it was regarded as the Common Sea-Eagle; and it was not uutil its gradual change of plumage had at length rendered obvious its true character, that it was ascertained to be in reality a distinct species. The same error appears frequently to have existed with regard to it; aud M. Temminck observes that the only mark of distinction that can be traced iu it until it has assumed the adult colouring, consists in the somewhat greater length of its tail. He might however have added its smaller size, which is probably one-fourth less than that of the preceding bird, at the same age and under similar circumstances. From the observations which we have been enabled to make upon tho subject, we should be led to conclude that the period in which it attains its full growth and perfect colouring is, in this country at least and in captivity, two or three years longer than that stated by Wilson. Iu its immaturo state, that is to say about the third year, the upper parts of the head and body exhibit a mixture of brown and dirty white, the separate feathers having a ground of the latter colour, and being deeply tipped and broadly barred along the centre with the former. The quill-feathers and primary wing-coverts are black, with their shafts of a pale-brown; the secondary are considerably lighter; and the tail, which projects iu a trifling degree beyond the extremities of the wings, is brown ou tho outer quills and of a mixed white and brown on the inner. The under surface, as far backwards as the middle of the belly, is of a much lighter shade than the upper, being of a dull white, with numerous broad streaks of pale-brown. In the posterior part it is of a deep brown, the feathers beiug only slightly margined with whito. A similar hue prevails ou the upper parts of the legs, which are plumed somewhat below the knees. The beak is of a dusky brown; the cere and legs of a golden yellow; the iris somewhat lighter; and the talons deep blackish-browu. Tho latter are long, strougly curved, of considerable power, and extremely sharp at the poiuts. The full-grown bird measures upwards of 3 feet in length from beak to tail, and more than 7 feet iu the expanso of its wings. Its beak is changed to a bright-yellow; and its head, a greater or less proportion of the neck (accordiug as the bird is more or less advauced in age), aud the entiro tail, aro become perfectly white. An analogous change, as we have before seen, takes place in the plumage of the preceding species; but the head aud neck of that bird always retain more or less of a brownish tinge, seldom changing fully into gray, and never turuing completely white. These observations have been made upon numerous individuals, many of them placed for upwards of ten years under the eyes of various scientific observers: their accuracy may therefore be regarded as unquestionable. The remainder of the plumage in this state is of a deep brown, approaching to black, and strongly contrasted with the head and tail. The colour of the legs, feet, and talons remains nearly the same; but the iris generally continues to assume a lighter and a lighter hue. The eyes, it should be observed, are deeply sunk in the head, and instead of being placed in a line parallel with that of the cheeks, are directed forwards, so as to form with them a considerable angle."

We have already given an account of the robberies committed by the Bald Eagle on the osprey; but its acts of plunder are not confined to that bird, for it will rob the vultures, and even in hard times make them disgorge their carrion to satiate its appetite. According to Audubon it will strike down a swan and other aquatic birds, and now and then procure fish for itself by pursuing them in shallow creeks; it also devours young pigs, lambs, fawns, and putrid flesh of every description. Niagara is one of its favourite haunts, where it watches for the swollen carcasses that the cataract has precipitated down the falls. Wilson saw one seated on a dead horse, keeping a whole flock of vultures at a distance till it had satisfied itself; and on another occasion, when many thousands of tree-squirrels had been drowned in their migration across the Ohio, and had collected hosts of vultures, the sudden appearance of a Bald Eagle sent them all off, and the eagle kept sole possession for many days.

Benjamin Franklin thus speaks of this emblem of the United States of America:—"For my part, I wish the Bald Eagle had not been chosen as the representative of our country. He is a bird of bad moral character; he does not get his living honestly. You may have seen him perched on some dead tree, where, too lazy to fish for himself, he watches the labours of the fishing-hawk; and when that diligent bird has at length taken a fish, and is bearing it to his nest for the support of his mate and young ones, the Bald Eagle pursues him and takes it from him. With all this injustice, he is never in good case, but, like those among men who live by sharping and robbing, he is generally poor, and often very lousy. Besides, he is a rank coward: the little King-Bird, not bigger than a sparrow, attacks him boldly, and drives him out of the district. He is therefore by no means a proper emblem for the brave and honest Cincinnati of America, who have driven all the King-Birds from our country; though exactly fit for that order of knights which the French call Chevaliers d'Industrie."

With regard to its reproduction, M. Audubon says that incubation commences in the beginning of January. He shot a female on the 17th of that month, as she sat on her eggs, in which the chicks had made great progress. "The nest," says that author, "which in some instances is of great size, is usually placed on a very tall tree, destitute of branches to a considerable height, but by no means always a dead one. It is never seen on rocks. It is composed of sticks from three to five feet in length, large pieces of turf, rank weeds, and Spanish moss in abundance, whenever that substance happens to be near. When finished, it measures from five to six feet in diameter, and so great is the accumulation of materials, that it sometimes measures the same in depth, it being occupied for a great number of years in succession, and receiving some augmentation each season. When placed in a naked tree, between the forks of the branches, it is conspicuously seen at a great distance. The eggs, which are from two to four, more commonly two or three, are of a dull white colour, and equally rounded at both ends, some of them being occasionally granulated. Incubation lasts for more than three weeks, but I have not been able to ascertain its precise duration, as I have observed the female on different occasions sit for a few days in the nest before laying the first egg. Of this I assured myself by climbing to the nest every day in succession, during her temporary absence." ('Ornithological Biography,' vol. i.)

This bird is found in every part of the United States of America, seldom appearing, according to Audubon, in very mountainous districts, but preferring the low lands of the sea-shores, those of the larger lakes, and the borders of rivers. Mr. Bennett remarks, that the White-Headed Eagle is usually spoken of as inhabiting the northern parts both of the old and new continent; but that it appears to be only a rare and occasional visitant of the former. It is probable, he adds, that some of the varieties of the Common Sea-Eagle of this quarter of the globe have been frequently mistaken for it, and remarks, that throughout nearly the whole of North America, on the contrary, where the European species seems to be unknown, it is met with in great abundance. Sir John Richardson says that it is the earliest of the summer visiters to the Fur Countries, and the period of its arrival has given the name of Meekeeshew Espeeshim, or Eagle-Moon, to the month of March. "Temminck," says Sir John ('Fauna Boreali-Americana'), "assigns for its habitual residence the regions within the Arctic Circle; and Wilson observes, that it is found at all seasons in the countries it inhabits. Both these assertions however require, I apprehend, to be taken with considerable latitude. We did not, on the late expeditions, meet with it to the north of the Great Slave Lake (62° N. lat.), although it is common in the summer, in the country extending from thence to Lake Superior, and its breeding-places in the latter district are numerous. But in the month of October, when the rivers from which it draws its principal supply of food are frozen over, it entirely quits the Hudson's Bay lands; and if, after that period, it is to be seen in the northern regions, it can only be on the sea-coast, and for a limited time, while the sea continues unfrozen. . . . It is known to breed as far south as Virginia, but its nests do not appear to be so common within any part of the United States as they are in the Fur Countries." The bird is not mentioned in the 'Supplement' to Sir W. E. Parry's 'First Voyage,' nor in that to Sir John Ross's 'Last Voyage.'

This bird is the Meekeeshew (name for the species), Wapustiquan-Meekeeshew (White-Headed Eagle—mature bird), Appisk-Meekeeshew (Black-Headed Eagle—immature bird), and Meekeeseeseeah (yearling birds) of the Cree Indians.

Colonel Sykes notes among the birds of Dukhun (Deccan) *Haliæetus Ponticerianus*, *Falco Ponticerianus* of Latham, Brahmuny Kite of the Europeans in India. The colonel says that it is seen constantly passing up and down rivers at a considerable height, but prepared to fall at an instant on its prey. Usually it seizes while on the wing, but occasionally dips entirely under water, appearing to rise again with difficulty. It is quite a mistake, he adds, to suppose it feeds on carrion. On the examination of the stomach and craw of many specimens, the contents were found to be fish, and fish only, excepting on one occasion, when a crab was met with. ('Zool. Proc.,' 1832.)

Leaving the Fishing Eagles, Mr. Vigors proceeds to

Circætus (Vieillot).—Beak convex above; nostrils lunulate, transverse; cere subhispid; tarsi elongated, naked; acrotarsia reticulated; toes short, the external toe connected with the middle one at the base; claws short, subequal. This genus is founded upon the well-known Jean de Blanc of the European continent, *Falco brachydactylus* of Wolff, *F. Gallicus* of Gmelin, Aquilotto of the Italians. Here Mr. Vigors observes, we find the exterior toe united to the middle by a short membrane, which is the case indeed in the greater portion of the family, while in the two latter genera the toes are all divided to the origin.

C. brachydactylus is, according to Temminck, the *Falco brachydactylus* of Wolff; the *Aquila brachydactyla* of Meyer; *Falco Gallicus* of Gmelin; *F. leucopsis* of Bechstein; *Aquila leucamphoma*, 'Borkh. Deut. Orn.'; Le Jean le Blanc of Buffon and the French generally; Aigle Jean le Blanc of Temminck; Falco Terzo d'Aquila, 'Stor. deg Ucc.'; and Kurzzehiger-Adler of Meyer.

Head and foot of *Circætus brachydactylus*.

Old Male.—Head very large; below the eyes a space clothed with white down; summit of the head, cheeks, throat, breast, and belly, white, but variegated with a few spots of bright brown; back and coverts of the wings brown, but the origin of all the feathers of a pure white; tail square, gray-brown, barred with deeper brown, white below; tarsi long and grayish-blue, as are the toes; beak black; cere bluish; iris yellow. Length, two feet.

Female.—Less white than the male. The head, the neck, the breast, and the belly, are marked with numerous brown spots, which are very much approximated.

Young.—Upper parts darker, but the origin of the feathers pure white; throat, breast, and belly, of a red-brown, little or not at all spotted with white; bands on the tail nearly imperceptible; beak bluish; feet grayish-white.

It feeds on lizards and serpents, to which it gives the preference; rarely birds and domestic poultry. The nest is built on the highest trees, and the eggs are two or three in number, of a lustrous gray, and spotless.

It inhabits the great fir forests of the eastern parts of the north of Europe; not common in Germany and Switzerland; rare in France; never seen in Holland. (Temminck.) Prince C. L. Bonaparte notes it as rather rare near Rome. Colonel Sykes notes it among the birds of the Dukhun (Deccan).

Dr. Smith's *Circaëtus pectoralis*, which undergoes many changes of plumage before it arrives at maturity ('South African Museum and Catalogue'), is stated ('Zool. Proc.,' April, 1833) to be synonymous with *Circætus thoracinus* of Cuvier.

Mr. Vigors next proceeds to the True Eagles.

Aquila (of Authors).—Beak sub-angular above; nostrils rounded; cere sub-hispid; tarsi plumed to the toes.

Mr. Vigors observes that the predominant mark of distinction in this genus is the tarsi being feathered to the toes. The culmen of the bill appears also to differ from that of the other Eagles in being more angular. The species *Aquila heliaca* of Savigny, *Falco chrysaetos*, and *Falco nævius* of Linnæus, *Falco bellicosus* of Daudin, with some others lately made known to us, belong to the group which contains the most powerful birds of the family.

A. chrysaetos, the Golden Eagle; Adler of the Germans; Eryr Melyn of the Welsh.

Leg and foot of Golden Eagle (*Aquila chrysaetos*).

Old Birds.—Summit of the head and nape with acuminated feathers of a lively and golden-red; all the other parts of the body obscure brown, more or less blackish, according to the age of the individual; inside of the thighs and feathers of the tarsus clear brown; never any white feathers among the scapulars; tail deep gray, barred with tolerable regularity with blackish-brown, and terminated at the end by a large band of that colour; beak horn-colour; iris always brown; cere and feet yellow. In this state Temminck considers it to be the *Aquila fulva* of Meyer; *Falco niger* of Gmelin; *F. fulvus* and *F. Canadensis* of Gmelin; *F. chrysaetos* of Linnæus; L'Aigle Royal of Buffon; Le Grand Aigle of Gerard, 'Tab. Elem.'; L'Aigle Commun and L'Aigle Royal of Cuvier; Ring-Tail Eagle and Golden Eagle of Latham; and Aquila Reale di Color Leonato and Aquila Rapace, 'Stor. deg. Ucc.'

Young Birds of one and two years. (Ring-Tail Eagle.)—All the plumage of a ferruginous or clear reddish-brown, uniform on all parts of the body; lower tail-coverts whitish; inside of the thighs and feathers of the tarsus of a pure white; tail quite white from the base to three-fourths of its length, but afterwards brown to the end; internal barbs of the quills and of the caudal feathers pure white—this same colour occupies also the greatest part of all the feathers of the body from their base. In proportion as the young bird advances in age the colours of the plumage become brown, the white of the tail occupies less space, and traces of the transverse bars appear. In the third year the young bird puts on his adult plumage.

Golden Eagle (*Aquila chrysaetos*).

Varieties.—Partially or totally white. (*Falco albus* of Gmelin *F. cygneus* of Latham; L'Aigle Blanc of Brisson.)

The Golden Eagle preys on lambs, fawns, &c., and often on large birds. Extreme hunger will drive it to prey on carcasses.

It inhabits the great forests in plains, and in a less degree those in the mountains of the north of Europe; very common in Sweden, in Scotland, in the Tyrol, Franconia, and Suabia; more rare in Italy and Switzerland; rather common in France, in the forest of Fontainbleau, in the mountains of Auvergne, and on the Pyrenees; rare in Holland; less common in the Oriental countries than the preceding species, that is, *Aquila heliaca* of Savigny, *A. imperialis* of Temminck. (Temminck.) According to Wilson the Golden Eagle inhabits America, and occurs from the temperate to the arctic regions, particularly in the latter, where it breeds on precipitous rocks, always preferring a mountainous country. Sir John Richardson ('Fauna Boreali-Americana') mentions it with a query as breeding in the recesses of the subalpine country which skirts the Rocky Mountains, and as seldom seen farther to the eastward. "It is," he says, "held by the aborigines of America, as it is by almost every other people, to be an emblem of might and courage, and the young Indian warrior glories in his eagle plume as the most honourable ornament with which he can adorn himself. Its feathers are attached to the calumets, or smoking-pipes, used by the Indians in the celebration of their solemn festivals, which has obtained for it the name of the Calumet Eagle. Indeed so highly are these ornaments prized that a warrior will often exchange a valuable horse for the tail-feathers of a single eagle." It is the Kœoo of the Cree Indians. Sir John Richardson observes that the mature British Golden Eagle has a darkish brown tail and wings, blackish-brown back, clouded with brownish-black, and a paler and brighter brown head. He had not seen an American one in this state, but we do not think that any reason for a doubt. Many other authors mention the eagle and ring-tails in such terms as to leave the identity of the bird almost unquestionable; and though Sir John Richardson says that it is seldom seen farther to the eastward than the Rocky Mountains, M. Audubon relates that he saw a Golden Eagle on the coast of Labrador, besides others in various parts of the United States. It inhabits Russia, Iceland, and Germany, and is said to occur in northern Africa and Asia Minor. Mr. Yarrell, in his 'History of British Birds,' thus sums up its localities in our islands:—"The Golden Eagle, though occasionally seen and sometimes obtained in the southern counties of England, is more exclusively confined to Scotland and its western and northern islands. Some years ago a specimen was killed at Bexhill, in Sussex. It has also occurred, but very rarely, in Suffolk, Norfolk, Derbyshire, Durham, and Northumberland. Mr. Mudie, in his 'Feathered Tribes of the British Islands,' has named 'the higher glens of the rivers that rise on the south-east of the Grampians, the high cliff called Wallace's Craig on the northern side of Lochlee, and Craig Muskeldie on its south side,' as localities for the Golden Eagle. Mr. Selby and his party of naturalists observed this species in Sutherlandshire in the summer of 1834. Mr. Macgillivray, in his detailed descriptions of the rapacious birds of Great Britain, has recorded his own observations of this species in the Hebrides; and other observers have seen it in the Orkney and Shetland Islands, where it is said constantly to rear its young. In a direction west of London the Golden Eagle has been obtained or seen on the coasts of Devonshire and Cornwall. In Ireland a Ring-Tailed Eagle (the young of the Golden) was seen by a party of naturalists in Connamara in the autumn of 1835; and from William Thompson, Esq., vice-president of the Natural History Society of Belfast, to whom I am indebted for a catalogue and notes of the birds of Ireland, which will be constantly referred to throughout the work, I learn that specimens of the Golden Eagle are preserved in Belfast, which were obtained in the counties of Donegal and Antrim." The longevity of the eagle is almost proverbial. One that died in Vienna is said to have lived in confinement 104 years. Colonel Sykes notes the Golden Eagle among the birds of the Dukhun (Deccan). His specimen differed so slightly from the European bird as not to justify its separation. ('Zool. Proc.,' 1832.)

In the catalogue of birds collected on the Ganges between Calcutta and Benares, and in the Vindhyian Hills between the latter place and Gurrah Mundela, on the Nerhudda, by Major James Franklin, F.R.S., &c., we find recorded an eagle, *Aquila Vindhiana*, with a query whether it is the Cawnpoor Eagle of Latham ('Zool. Proc.,' 1831), and among the Dukhun birds, *Aquila bifasciata* of Hardwicke and Gray. ('Ind. Zool.') A whole rat was found in the stomach of one bird. A second was shot by Colonel Sykes at the dead carcass of a royal tiger, but it had not fed, for the stomach was empty. Dr. Smith stated ('Zool. Proc.,' 1833) that the eagle from the Cape presented to the Society by the Hon. J. T. Leslie Melville, and in the Society's menagerie, was not the young of *A. vulturina* (Daudin), but of *A. Choka* (Smith), *Falco rapax* (Temminck). Specimens of *A. bellicosa* and *A. rapax* are in the South African Museum, as well as of *A. vulturina*. The first is only found in wooded districts, preys upon small quadrupeds, and has been known to pounce upon small antelopes and carry them off entire to its nest. *A. rapax*, though it principally preys on living creatures, does not wholly reject carrion, being frequently one of the first birds that approaches a dead animal. ('Catalogue of South African Museum.') Mr. Keith Abbott ('Zool. Proc.,' 1834) notes among the Trebizond birds *A. pennata*, inhabiting Eastern Europe and the adjacent parts of Asia and Africa.

Hæmatornis (Vigors).—Beak rather strong, sufficiently elongated; upper mandible straight at the base, very much curved at the apex; nostrils oval, placed obliquely in the cere. Wings long, subrounded; the first quill rather short, the second and third longer, the fourth and fifth nearly equal and longest, the rest gradually decreasing. Feet rather weak, subelongated; tarsi rough, reticulated with scales; toes rather short, reticulated; claws strong. Tail sufficiently long, somewhat rounded. (Vigors.)

This group was observed to bear a near affinity to the genus *Pandion* in the shape of the bill, wings, and the rugose reticulated scales of the tarsi, but to differ from it in the comparative length and weakness of the legs and claws, as well as in having the nails grooved underneath, and not convex as in the latter group. To this genus belongs the *Falco Bacha* (Latham) of Africa, and the Manilla bird then lately described in the 'Proceedings' (page 96) under the name of *Buteo holospilus*. These, from the apparent weakness of their limbs, had hitherto generally been ranked among the buzzards; although from the description of the courageous habits of the Bacha Falcon, the only one well known of the group, doubts had been expressed of the propriety of ranking them with that tribe. Mr. Vigors suggested the sub-family of Eagles as a more appropriate station for them; where, united by many important characters to *Pandion*, they apparently led off by the length of their tarsi to the genus *Limnaëtus* ('Memoirs of Sir S. Raffles') and others of the long-legged Eagles. The three species of the group were exhibited, their general similarity in colour and markings pointed out, and their specific differences explained. These consist chiefly in size, *H. holospilus* being one-third smaller than *H. Bacha*; while *H. undulatus* (which is 2 feet 7 inches in length) considerably exceeds the latter. The first is spotted all over the body, the second only on the abdomen, while the third is marked by spots on the wing-coverts, and by ocelli bearing an undulated appearance upon the abdomen, the breast also being crossed by undulating fasciæ. A specimen of *H. undulatus* was afterwards (January 1832) exhibited from Mr. Hodgson's Nepaul collection. It agreed accurately with that which had been previously exhibited except in size, the present specimen being about one-third longer. From this difference in size it was conjectured to be a female. Colonel Sykes identified a specimen shot in the Dukhun (Deccan) with *Hæmatornis Bacha*. ('Zool. Proc.')

H. undulatus (male and female probably). Back and wings intense brown; head crested, the feathers white at the base, of a dark brown, nearly approaching to black at the end, the hind ones being margined with a light rufous band at the apex. The wing-coverts near the carpal joint deep brown, marked with small white spots; quill-feathers fuscous, darker at the apex, and marked with white towards the base of the interior web; the cere, base of the beak, and legs, yellow; claws black. (Vigors, in Gould's 'Century of Birds from the Himalaya Mountains.')

Hæmatornis undulatus.

** Short-Winged Eagles.

Harpyia (Cuvier). — Beak above convex; upper mandible slightly toothed; nostrils semilunar, transverse; tarsi elongated, very strong, feathered at the base; acrotarsia scutellated; claws long, very strong, acute.

Mr. Vigors, in placing *Harpyia* next to *Aquila*, observes that the former equals the latter in size and powers of body. Its tarsi, he remarks, are strong, thick, partly plumed, with scutellated acrotarsia. The nares are elongated, apparently semilunar, and placed transversely on the cere. The upper mandible, he adds, seems to have a notch somewhat analogous to that of the True Falcons.

Falco imperialis (Shaw). This powerful bird is the Grande Harpie d'Amerique of the French; Aquila Corouada of the Spanish; *Falco destructor* of Daudin; Aigle Destructeur of Sounini; Grand Aigle de la Guiane of Mauduyt; *Harpyia destructor* of Cuvier. Mr. Vigors states with truth that much confusion has arisen as to the synonyms of this bird, and even as to the characters of the genus. Mr. Bennett has, in our opinion, well cleared this confusion away, and we therefore select his synonymy.

"M. Temminck," says the last-mentioned zoologist ('Gardens and Menagerie of the Zoological Society'), "the latest writer on this magnificent bird, positively denies its identity with the *Vultur harpyia* of Linnæus, and the Crowned Eagle (*V. coronatus*) of Jacquin, on the singular ground that those names indicate a smaller bird with longer and more slender legs. Now Linnæus, who borrowed his original description of the Harpy from Hernandez, asserts, on the authority of that writer, that it is equal in size to a common ram; and Jacquin states his bird to have measured full two feet and a half in height in its natural sitting posture, and almost two inches in the diameter of its legs. It is impossible to read the descriptions of Hernandez and Jacquin, making in the case of the former some little allowance for exaggeration, without feeling a conviction that they both refer to the bird now under consideration. That of the latter author in particular is admirably characteristic. Linnæus originally founded his species on the indication given by Hernandez; in the tenth edition of his 'Systema' he suggested a comparison between it and a bird seen by a friend, probably a pupil, in the Royal Menagerie at Madrid, which there is every reason to believe from the description given to have been just. It was only in the twelfth edition of his immortal work that he introduced a slight confusion by adding to the citation from Hernandez to the account furnished by his friend, and to some particulars extracted from Jacquin's then unpublished description of his supposed species, a synonym from Marcgrave, which can alone justify M. Temminck's criticism. We restore without hesitation both these synonyms of Linnæus and Jacquin, excluding only from the twelfth edition of the 'Systema Naturæ' the references to Marcgrave and his copyists. With the *Vultur harpyia* of Linnæus and the

V. coronatus of Jacquin are necessarily included among the synonyms of the Harpy Eagle, the *Falco harpyia* and the *F. Jacquini* of Gmelin, by whom the trivial name assigned by Jacquin to his bird was changed on account of its introduction into a genus in which that appellation was pre-occupied. In the year 1778, Mr. Dillon observed in the menagerie of Buen Retiro at Madrid, a species of eagle which he imagined to be 'an undescript kind not taken notice of by Linnæus.' This bird, which he figures in his 'Travels through Spain' under the name of the Crested Falcon, is evidently of the same species with the Harpy, although the representation is rudely executed, and in some respects, as for example the length of the beak, grossly caricatured. We might almost be tempted to suspect that the specimen seen by him was identical with that described by Linnæus from the same menagerie twenty years before, were it not that the latter bird is expressly called Mexican, while that of Mr. Dillon is stated to have come from the Caracas. For this reason Dr. Latham introduced it into his 'Synopsis' under the name of the Caraca Falcon.

"Gmelin, quoting from Latham, soon after latinised its former name into *Falco cristatus*, and this may therefore be added to the synonyms of our bird, of which Mr. Dillon's was the first published figure. The next original describer of the Harpy Eagle was Mauduyt, who also regarded his specimens as nondescript, and gave them the name of Grand Aigle de la Guiane, from the country whence they were obtained. To these birds, which formed part of the collection of the Paris Museum, Daudin, in his 'Ornithology,' published in 1800, applied the scientific appellation of *Falco destructor;* and the names given by these two writers have been generally adopted on the continent of Europe as the only ones certainly applicable to the species. M. Sonnini seems doubtful whether or not to regard the two specimens described by him as distinct species, and names the one Aigle Destructeur, and the other Grand Aigle de la Guiane; but there seems no sufficient reason for their separation. Dr. Shaw's *Falco imperialis* is founded on this indication of Sonnini. In all probability the Crested Eagle of Stedman's 'Expedition to Surinam,' spoken of as a very strong and fierce bird, belongs to the same species. Figures of the Harpy are likewise given by M. Cuvier in his 'Règne Animal;' by M. Vieillot, in the second edition of the 'Nouveau Dictionnaire des Sciences;' and by M. Temminck, in his 'Planches Coloriées.' Those of the two last-named works are strikingly characteristic. That of the 'Dictionnaire' exhibits the crest-feathers equally and stiffly elevated round the back part of the head, a state in which we have never seen them in our bird, and which on account of their laxity, and the lower position of the middle ones, we doubt their power to assume. It is right however to remark that the crest is stated by Linnæus and other authors to possess this power of elevation round the head in form of a crown, an ornament alluded to in the Spanish name of the bird, Aquila Coronada, and in the trivial appellation, *coronatus*, affixed to the species by Jacquin. We believe that we have now restored to this bird all the original synonyms which unquestionably belong to it. The original descriptions of Hernandez, Linnæus, Jacquin, Mauduyt, Daudin, and Sonnini, and the figures of Dillon, Shaw, Cuvier, Vieillot, and Temminck, are such as leave no doubt upon our minds of the accuracy of the references to those authors. We have purposely abstained from mentioning others which have been occasionally quoted, but which either do not appear to us to be satisfactorily determined, or are evidently founded on mistake. Of the former class the Owyra-Ouassou of Lery, or Royal Bird of Prey of Brazil, may serve as an example; of the latter, the Calquin and Tharu of Molina."

Adult Bird.—Head with thick downy plumage, of a light slaty-gray colour. Crest arising from the back part, of numerous broad feathers increasing in length towards the middle line of the head, and thus assuming a rounded form, of a dull black, with the exception of a slight margin of gray on the tips of the longer feathers, and a more extensive tinge of the same colour on those of the sides. This crest is slightly raised above the level of the feathers of the back of the neck when the bird is quiet, but is capable of being elevated at right angles with them upon any sudden excitement. In this state, to an observer placed in front of the bird, the middle feathers of the crest are rarely visible, on account of their being inserted much lower down than the lateral ones; while the latter, converging on either side, form, as it were, two lax ear-like processes. Below the crest, the whole of the back and wings, together with a broad collar round the fore part of the neck, black, each of the feathers of the back terminating in a narrow transverse somewhat lighter streak. Under surface, from the breast backwards, pure white; plumage of the legs white with blackish transverse bars. Tail with four transverse black bands, of about equal breadth with the four alternating whitish or ash-coloured spaces; the tip light ash. (Bennett).

Immature Bird.—Upper parts mottled with brown, gray, and whitish; cheeks, occiput, throat, and under parts, light gray, with a few black feathers in front of the neck, and some large irregular black spots on each side of the lower surface of the tail-feathers on a light ash-coloured ground. (*Falco imperialis*, Shaw; Vieillot, young female ?). Back and wings grayish fawn-colour, irregularly marbled and spotted with black; collar ashy-fawn, more or less spotted with black; bars crossing the legs fewer and more irregular; all the lower parts whitish-fawn sprinkled with darker spots; upper surface of tail ash-coloured, with small blackish spots; patches of black mark the places of the future bands, which gradually increase at each change; under surface whitish, dotted with fawn. (Temminck.)

Bird farther advanced.—Collar, crest, back, and wing-coverts, almost uniformly gray; quill-feathers of the wings black; under surface of body dirty white; each of the tail-feathers marked beneath by four large black patches crossing its shaft and occupying about half its width. (Bennett.)

Upper mandible very thick at the base, straight for some distance, and suddenly curving downwards with a strong arch towards the sharp point; lower mandible straight, short, and blunt; nostrils transverse and oval; wings when closed not reaching beyond the middle of the tail, which is rounded at the extremity; legs feathered on the upper part of their anterior surface only, the rest naked and reticulated; talons extremely strong, internal and posterior ones very long. Mr. Bennett observes that in some of these characters, as for instance the nakedness of the legs, the Harpy approaches the Sea-Eagles; but it differs from them in many essential points, and in none more remarkably than in the shortness of its wings, and the robustness of its legs and talons; the former character rendering it, like the short-winged hawks, more adapted for preying near the surface of the ground on gallinaceous birds and quadrupeds, and the latter enabling it to carry off a prey of much greater magnitude.

Harpy Eagle (*Harpyia destructor*).

The Harpy is stated to be a solitary bird, frequenting the thickest forests, where it feeds upon the sloths; it also preys on fawns and other young quadrupeds. Sonnini observed it sitting motionless and uttering no cry, on a high tree on the banks of the Orapu. Hernandez does not seem inclined to detract from the powers of the bird, for he says that it will attack the most fierce beasts, and even man himself; and he further states that it may be trained like a hawk to pursue game. Linnæus gives the bird credit for strength sufficient to split a man's skull with a single blow (unico ictu). These accounts of its prowess must be taken with some grains of allowance, but that the bird is very powerful is without doubt. Jacquin's specimen was found dead in the ship that was conveying it to Europe, and its death was with some probability attributed to the sailors, whose monkeys the eagle had destroyed. When these animals gambolled too near its cage they were seized by its talons and devoured with almost all their bones, but not their skin, which the bird invariably stripped off. One Harpy which was obtained by Mr. Hesketh, consul at Maranham, near the mouth of the river Amazonas, and brought to England by Colonel Sabine, is said to have destroyed and eaten a King of the Vultures (*Sarcoramphus Papa*) while on its passage to England. After its arrival a cat was put into its cage, and the eagle, with one blow of its immense foot, broke its back.

It inhabits Mexico (Hernandez, Linnæus, and others); the neighbourhood of the river Magdalena, in New Granada (Jacquin); Caracas (Madrid specimen); Guyana (Sonnini).

Morphnus (Cuvier.)—Beak convex above; nostrils elliptical; tarsi elevated, rather slender; acrotarsia scutellated; toes rather short; claws acute.

Mr. Vigors observes, that this genus differs from *Herpyia* in its more slender, lengthened, and scutellated tarsi, and the comparative weakness of its toes. It is separated into two sections, as the tarsi are plumed or otherwise; among the former M. Cuvier arranges *Falco occipitalis*, *F. ornatus*, and *F. albescens* of Daudin, and *F. maculosa* of Vieillot; among the latter, *F. Guianensis* of Daudin, and *F. Urubitinga* of Gmelin. *Spizaëtus* of Vieillot corresponds with this group.

a. Tarsi naked.

M. Urubitinga, *Falco Urubitinga* of Gmelin, *Aquila Brasiliensis* of Brisson, Brasilian Eagle of Latham, Urubitinga of Marcgrave, Willughby, Ray, and others. The following is Willughby's:—This bird is like an eagle, of the bigness of a goose of six months old. It has a thick hooked black beak; a yellowish skin (cere) about the nostrils; great sparkling aquiline eyes; a great head; yellow legs and feet; four toes in each foot, disposed after the usual manner; crooked, long, black talons; large wings; a broad tail. It is all over covered with dusky and blackish feathers; yet the wings are waved with ash colour. The tail is nine inches long, white for six, the end for three inches being black; howbeit in the very tip there is again a little white.

Head and foot of Brasilian Eagle (*Morphnus Urubitinga*).

Young of the Year.—Blackish-yellow below; the centre of each feather marked with blackish-brown tear-like spots; throat and cheeks with brown striæ on a whitish ground. Locality, Brazil and Guyana, where it is said to seek its prey on inundated places.

b. Tarsi feathered.

M. occipitalis, *Falco occipitalis* of Daudin, L'Aigle Autour Noir Huppé d'Afrique, and Huppart. It is the size of a crow; black, with a long crest or tuft dependant from the occiput; tarsi, edge of the wing, and bands on the tail, whitish. It is a native of Africa.

Cymindis (Cuvier).—Beak convex above; nostrils nearly closed, rimiform; tarsi short, semipalmated.

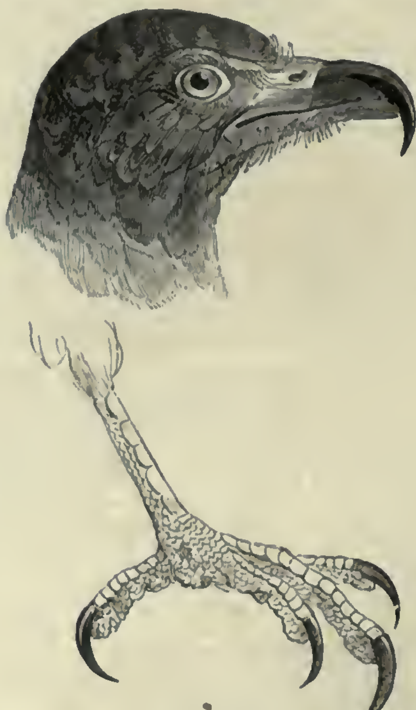
Distinguished by their short, half-plumed, and reticulated tarsi, and more particularly by their nostrils being nearly closed, and bearing the appearance of a narrow slit or channel.

a. Acrotarsia scutellated.

C. hamatus, *Falco hamatus* of Illiger.

Head and foot of Huppart (*Morphnus occipitalis*).

Adult.—Upper mandible extremely hooked; cere and feet yellow; all the plumage uniform lead colour. Length 15 inches 8 lines French.



Head and foot of *Cymindis hamatus*.

Young of the Year.—Plumage sombre brown, each feather bordered and blotched with red; summit of the head and cheeks marked with yellowish elongated spots; a yellowish band below the eyes; front of the neck whitish. It is a native of Brazil.

b. Acrotarsia reticulated.

C. Cayennensis, *Falco Cayennensis* of Gmelin, Petit Autour de Cayenne.

Summit of the head ash-coloured; back (manteau) brown, barred with deeper brown; belly white; tail gray, barred with white beneath; feet ash-coloured. It is a native of Cayenne.

Head and foot of *Cymindis Cayennensis.*

Asturina (Vieillot).—Beak couvex above; nostrils lunulate; tarsi short, somewhat slender; claws long, very acute.

A. cinerea. Bluish ash-colour; whitish bands on the under part of the body; tail traversed by two black stripes, white at the point; beak blue below; cere blue; feet yellow. It is a native of Guyana.

Head and foot of *Asturina cinerea.*

Mr. Vigors observes, that it is among these Short-Winged Eagles that the greatest difficulty prevails in deciding on their immediate affinities. Being for the most part extra-European, and not within the reach of general examination, their manners also being but little noted, and the characters on which we depend for formiug our decision respecting their affinities being for the most part passed over in the descriptions given of them, it is only by conjecture that we can assign them a place in the general arrangement. Of this nature, he remarks, is the genus last described. The same difficulty, he adds, extends to several other described species of the *Falconidæ*, which appear to him to belong to the group of Short-Winged Eagles, although they have been assigned a different locality by the authors who have described them. Among these is the *Falco Bacha* of Daudin, which has been generally rauked with the Buzzards. Its short wings and lengthened bill however seem, accordiug to Mr. Vigors, to bring it among the present group of the Eagles; and its habits, as described to him by Dr. Horsfield, who had an opportunity of closely observiug them in the Island of Java, where the birds are by no means uncommon, do not in any respect correspond with the Buzzard tribe. Mr. Vigors would place it, together with *F. albidus* of Cuvier, near those species of the genus *Cymindis* which are distinguished by the reticulated acrotarsia, if uot in that genus itself. He has indeed some doubts whether most of the Short-Winged *Falconidæ* at present placed among the Buzzards, such as *F. buson* and *F. tachiro* of Daudin, *F. pœcilonotus* of Cuvier, &c., may not be more properly removed to a situation between the Short-Winged Eagles and the Hawks, with both of which tbey seem to have a considerable affinity. There is, continues Mr. Vigors, another group which also appears allied to the present, distinguished by a rather feeble and elongated bill, short wiugs, and slender lengthened tarsi, feathered to the toes. It includes *F. limnæctus* of Horsfield ('Zool. Res.,' No. 6), *F. niveus* of Temminck (Pl. Col. 127), and *F. atricapillus* of Cuvier (Pl. Col. 79). These appear to be strongly allied, in the opinion of Mr. Vigors, if not to appertain, to the before-mentioned genus *Morphnus*. *F. tyrannus* of Prince Maximilian (Pl. Col. 73) bears also, Mr. Vigors thinks, a strong similitude to the same group, though partially differing in external characters.

2nd Sub-Family *Accipitrina* (Hawks).

Beak short, hooked from the base; wings short, fourth quill longest.

Head and foot of *Dædalion cachinnans.*

"The short wings of the last groups," writes Mr. Vigors, "lead us to the present division of Hawks, all of which, a considerably extensive tribe, are characterised by their wings exteuding no further than two-thirds of the extent of their tail. The fourth quill-feather is the longest, the first, second, and third gradually exceeding each other in length. In this division we may observe that the upper mandible, though not furnished with distinct teeth like the True Falcons, has the festoon or prominence that generally supplies its place more strong and angular than is usual among these tribes. In some of the *Accipitres* this is particularly distinguishable. The sub-family we have just quitted includes all the birds of the present family in which the beak is straight at the base, and hooked only at the apex. We now enter upon the first of those groups where the bill is curved from the base, a character that extends through the remainder of the *Falconidæ*. It may be observed, that this character, which thus separates the family into two departments, was equally noticed as a mark of distinction between the species known to the ancients. Pliny, apparently referring to it as a line of demarcation between them, divides the group into his two departments of *Aquilæ* and *Accipitres*. It is from adopting the same views respecting the family, that M. Brisson instituted his two leading divisions, to which he assigned corresponding denominations."

Dædalion (Savigny).—Beak short; tarsi moderate; acrotarsia reticulated. Type, *Falco cachinnans* of Linnæus, and *F. melanops* of Latham.

Mr. Vigors adopts the name which was conferred by M. Savigny on the whole of the sub-family, for the present division of it.

D. melanops. Adult male—white, flamed with black on the neck and breast; back, wings, and tail, deep black, the last with a white stripe, and terminated with white; there are dots of the same colour on the coverts of the wings; cere and tarsi reddish. It is a native of Guyana. We have illustrated the form by *Dædalion cachinnans*.

Astur (Bechstein).—Beak short; nostrils suboval; tarsi moderate; acrotarsia scutellated.

Mr. Vigors observes that *Astur* is a title which has been applied to the whole group, but which may be confined to those whose tarsi, moderate in length, have their acrotarsia scutellated or covered with broad and even scales. He considers our European species, *Falco palumbarius* of Linnæus, as the type; to which may be added *F. Novæ Hollandiæ* of Latham, and a considerable number of corresponding species from every quarter of the globe.

A. palumbarius. This is the Autour and Atour of the French; Astore (Zinan.) and Girifalco (Bonaparte), Sparviere da Columbe, and Sparviere Terzuolo, of the Italians; Grosser Gepfeilter-Falck and Hunerhabicht of the Germans; Goshawk of the English, and Hebog Marthin of the Welsh.

A full-grown female measures from 23 to 24 inches in length; the males one-fourth, and sometimes one-third less; but when adult, the plumage is nearly similar. The beak is horn-colour or bluish-black; the cere and irides yellow; the top of the head, the whole of the back, upper surface of the wings, and tail-feathers, dark grayish-brown; in females the colour inclines to clove-brown; the upper surface of the tail-feathers barred with darker brown; a band passing over the lore, eyes, cheeks, and ear-coverts; the nape of the neck, throat, breast, belly, and thighs, nearly white, with spots, transverse bars, and undulating lines of dull black; under tail-coverts white; lore, cheeks, and ear-coverts, grayish-brown, forming an elongated dark patch on the side of the head; the legs and toes yellow; the claws black.

Young birds have the beak, cere, and eyes, nearly similar to those of the old birds; the top of the head, nape, and ear-coverts, ferruginous white, each feather darker in the middle; back, wings, and upper tail-coverts, brown, margined with buff; upper surface of the tail-feathers with five bands of dark brown and four bands of lighter brown, the ends of all the feathers white; wing-primaries dark brown, barred with two shades of brown on the inner webs: the chin, throat, breast, and belly, grayish-white, each feather with a central elongated patch of dark brown; thighs and under tail-coverts with a dark brown longitudinal streak instead of a brown patch; under surface of the wings grayish-white, with transverse dusky bars; under surface of the tail-feathers grayish-white, with five darker grayish-brown transverse bars, the tips of all the feathers white; legs and toes yellow-brown; the claws black; those of the inner toe considerably larger than those of the outer. (Yarrell.)

This bird flies low, and pursues its prey in a line after it, or in the manner called 'raking,' by falconers. If the game takes refuge it will sit patiently on a tree or stone till it moves, or till some other prey is accessible. Food—hares, rabbits, pigeons, pheasants, grouse, and partridges. The female was generally flown by falconers at fur, and the male at feather; but the female was also trained to take the larger winged game, the male being principally flown at partridges. Turbervile says, "You shal not neede to shew any other game to a goshawke for her first entring than a partridge, because in learning to flee the partridge they prove most excellent; and the first yeare you shall doe best to flee them to the field, and not to the covert, for so will they learne to hold out (and not to turne tayle) in the middest of their flight; and when they be mewed hawkes, you may make them doe what you will; and understand you, that you shall not neede to take such pain, nor to use such art in making of a goshawke which is taken a brancher as with a Nyasse, for she will alwayes know of her selfe what to doe." ('The Book of Falconrie.') Nest, on a high tree in the outskirts of the forest; rarely found in the interior, except in those parts which are open and free from timber. Eggs three or four, frequently hatched in the middle of May. (Hewitson, ex relatione Hoy.) Mr. Yarrell says that the eggs are rare, and that the few which he has seen were uniform in size and colour, 2 3/10ths inches in length by 1 11/16th inch in breadth, of a pale bluish-white, without any spots or streaks.

It is found in Denmark, Norway, Sweden, Siberia, Russia, and Chinese Tartary. (Müller, Linnæus, Pennant.) Very common in France, Germany, Russia, and Switzerland; more rare in Holland. (Temminck.) Rare in the south of England. Mr. Yarrell says, "The few that are used for hawking are obtained from the Continent. Colonel Thornton, who kept them constantly in Yorkshire, procured some of his specimens from Scotland. Dr. Moore, in his 'Catalogue of the Birds of Devonshire,' says that it is found occasionally on Dartmoor, but I can find no record of its appearance farther west in England, nor any notice of it in Ireland. A fine adult male was trapped by a gamekeeper in Suffolk in March, 1833; and Mr. Doubleday of Epping has sent me word that he received a young bird from Norfolk in the spring of the same year. Mr. Selby mentions that he had never seen a recent specimen south of the Tweed, but states that it is known to breed in the forest of Rothiemurcus, and on the wooded banks of the Dee. Mr. Low says that this species is pretty frequent in Orkney; but as he speaks of it in connection with sea-beaten rocks without shelter or woods, is there not reason to suspect that Mr. Low was mistaken, and that the birds he saw were Peregrine Falcons?—the more so, as several visitors to these northern islands have observed peregrines, but no goshawks." ('British Birds.') Prince C. L. Bonaparte has noted the goshawk as not common in the neighbourhood of Rome, and as rare in that of Philadelphia. Sir John Richardson ('Fauna Boreali-Americana') describes one shot in company with the female at the nest on the plains of the Saskatchewan, and states that another specimen was killed in the woody country three or four degrees of latitude farther north than the preceding. He records another killed near Jasper's House, on the Rocky Mountains, and a fourth killed at York Factory, supposed to be a young bird of the season (the specimen noticed by Mr. Sabine in 'Franklin's Journey').

Goshawk (*Astur palumbarius*).

The Falcon-Gentil is supposed to be the female and young of this species, which is the Ash-Coloured or Black-Capped Hawk of Wilson.

Colonel Sykes describes an *Astur* (*A. hyder*) among his birds of the Dukhun (Deccan), and there are specimens of *A. musicus* and *A. melanoleucus* in the South African Museum.

Accipiter (of Ray, Brisson, and authors).—Beak short; nostrils suboval; tarsi elongated, smooth; acrotarsia scutellated, the suture scarcely to be discerned. Type, the Common Sparrowhawk *Accipiter fringillarius* of Ray: to which, says Mr. Vigors, may be added many corresponding species which do not seem to have any limits to their geographical distribution.

A. fringillarius, the Sparrowhawk, is L'Epervier of the French; Falco Palombino and Sparviere da Fringuelli of the Italians; Die Sperber of the Germans; Sparfhoek of the 'Fauna Suecica;' *Falco Nisus* of Linnæus; Gwepia of the Welsh.

Adult Male.—About 12 inches in length; beak blue, lightest at the base; cere greenish-yellow; the irides yellow; top of the head, nape of the neck, back, wings, and wing-coverts, rich dark-brown—in very old males with a tinge of bluish-gray; tail-feathers grayish-brown, with three conspicuous transverse bands of dark brown; chin, cheeks, throat, breast, belly, thighs, and under tail-coverts, rufous, with numerous transverse bars of darker rufous brown; legs and toes long, slender, and yellow; the claws curved, sharp, and black.

Female.—Generally 3 inches longer than the male; beak bluish horn-colour; cere yellowish, the irides yellow; top of the head, upper part of the neck, back, wings, and tail-coverts, brown—the base of many of the feathers white, which, extending beyond the edge of the feather immediately above it, causes a white spot or mark; primaries and tail-feathers light brown, barred transversely with darker brown; under surface of the neck, body, wing-coverts, and thighs, grayish-white, barred transversely with brown; under surface of the wing and tail-feathers of the same colour, but the light and dark bars much broader; the first six wing-primaries emarginated; the fourth and fifth quill-feathers equal and the longest, the first quill-feather the shortest; legs and toes yellow; claws long, curved, sharp, and black.

Young Male.—Resembles the female; but the brown feathers of the back and the wing-coverts are edged with reddish-brown; feathers of the tail reddish-brown, particularly toward the base, with three conspicuous dark-brown transverse bands. In other particulars like the female: both have a collar formed by a mixture of white and brown, which extends from the sides of the neck to the nape. (Yarrell.)

The Sparrowhawk haunts wooded districts. It is the great enemy of small quadrupeds and birds, and is often very destructive to young chicks in poultry-yards in the breeding season. Used in falconry it is the best of all hawks for landrails. (Sebright.) "The Sparrowhawk generally takes possession of some old or deserted nest in a tree, most frequently that of the crow, in which the female deposits four or five eggs, each about 1 inch 7 lines long by 1 inch 4 lines broad, of a pale bluish-white, blotched and spotted with dark brown. The young are covered with a delicate and pure white down, and are abundantly supplied with food. Mr. Selby mentions having found a nest of five young sparrowhawks, which contained besides, a lapwing, two blackbirds, one thrush, and two green-linnets, recently killed, and partly divested of their feathers." (Yarrell.)

It is spread throughout Europe, Japan (Temminck), Smyrna (Mr. Strickland), Denmark, Sweden, Norway, Russia, and thence southward over the European continent to Spain and Italy. Common in most of the counties of England, and has been observed in the west and north of Ireland; occurs also in Scotland and its northern islands. (Yarrell.) Very common, migratory, near Rome. (Bonaparte.)

Head and foot of Sparrowhawk (*Accipiter fringillarius*).

The form is widely spread. Colonel Sykes records *Accipiter Dukhunensis* (resembling *A. fringillarius*, but differing in certain points), and *A. Dussumieri* among the birds of the Dukhun (Deccan). In the South African Museum will be found *Accipiter polyzonus*, *A. polyzonoides*, *A. niger*, *A. Gabar*, *A. Tachiro*, *A. minulus*, and *A. rufiventris*.

Mr. Vigors remarks that there are some species which seem to be allied to this sub-family and to be intermediate between it and the succeeding sub-family of Falcons, which, from some peculiarities of character, cannot well be appended to any established genus. They possess, he observes, a shortness of wing which would incline us to refer them to some of the present groups; but their upper mandible, strongly and doubly dentated, presents a character that will not admit of their being included in any of the foregoing genera, in which the mandibles are entire, or where the place of the tooth is supplied by a rounded prominence. These species Mr. Vigors would have wished to arrange in one genus; but they are found to differ in essential points which bring them respectively within the pale of the two conterminous sub-families now under consideration; and he feels obliged, for the sake of perspicuity, to adopt the following genus of which the type is *Falco bidentatus* of Latham.

Harpagus, Vigors (*Bidens* of Spix).—Beak short; upper mandible strongly bidentated, lower with a double notch; tarsi moderate; acrotarsia scutellated; third and fourth quills longest, equal.

Mr. Vigors observes that the essential characteristic of this group is the double tooth on both the upper and lower mandible. The wings, which correspond with those of the other Hawks, in being one-third shorter than the tail, have the third and fourth quill-feathers, which are the longest, of equal length. The tarsi are of moderate length and strength, and have the acrotarsia scutellated as in the latter groups of the present sub-family. The nostrils are of a semicircular form and the cere is naked.

H. bidentatus. Length, a foot and some lines (French). Slate-colour above; throat white; breast and belly red, undulated with yellowish; lower coverts of the tail white; tail nearly equal, brownish, barred with whitish. It is a native of Brazil and Guyana.

Head and foot of *Harpagus bidentatus*.

Mr. Vigors remarks that *Falco Diodon* of Temminck is to be referred to this genus.

Gampsonyx (Vigors).—Beak short, mandibles entire; nostrils rounded; wings short, second quill longest, third generally equal to the second, and internal web of the first and second strongly notched near the apex; tail moderate, equal; feet moderate; tarsi reticulated, acrotarsia feathered below the knee to the middle. (Vigors.)

"The genus is founded on a small and beautiful Hawk," writes Mr. Vigors in 'The Zoological Journal,' vol. ii., "which has been kindly submitted to my inspection by Mr. Swainson, one of the fruits of that gentleman's extensive researches in Brazil. This bird decidedly belongs to the Accipitrine sub-family of the *Falconidæ*; but it is placed at that remote extremity of it, where the species, gradually approaching the Falcons, partially assume some of their leading characters. It possesses the bill of the Hawks, and also the shortness of wing which so strongly characterises them; but the structure of the wing itself is the same as in *Falco*, the second quill-feather being the longest, and the first and second of these feathers being marked on the inner web by an abrupt emargination near the apex; while the tarsi also display the character of the same group in having the acrotarsia reticulated. The bird thus exhibits a striking modification of form, at once partaking of the chief of the respective characters of both the Hawks and Falcons; with the former of which it may in addition be observed that it agrees in its general form, and with some of the latter, particularly the beautiful group of *Ierax cærulescens*, in its colours, and in the general distribution of them. To the latter group indeed it has a striking resemblance, and might perhaps be referred unconditionally to it, could we pass over the important character of the untoothed bill."

G. Swainsonii. Above cineraceous-black, white beneath; front, cheeks, sides of the abdomen, and femoral feathers, orange; a black spot on each side of the breast. Beak black. Feathers of the back and scapulars ashy-black, spotted with ferruginous. Lower side and nuchal collar white, sparingly variegated with orange. Primaries blackish, internally margined with white at the apex; secondaries sparingly sprinkled with ferruginous, beneath white. Tail-feathers ashy-black, internally (the middle excepted) margined with white, beneath white. Feet yellow; claws black. Length of the body 9¾ inches. (Vigors.)

It is a native of Brazil. Mr. Vigors says that the following manuscript note was appended to this bird in Mr. Swainson's handwriting:—"The only individual of this species I ever met with was shot on the table-land, about ten leagues in the interior of Bahia, in a direction west-south-west from the bay of St. Salvador. It was perched on the trunk of a withered tree, apparently watching some small birds. The tarsi are bright and the irides hazel."

3rd Sub-Family, *Falconinæ* (Falcons).

Beak short, hooked from the base. Wings long. Second quill longest.

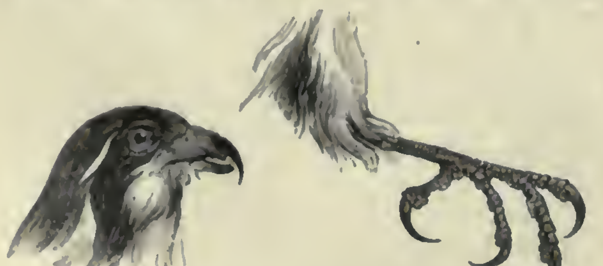
Mr. Vigors observes that this, closely allied to *Harpagus* by the double tooth on its upper mandible, is another group for which he proposes the name of

Ierax (Vigors).—Beak short; upper mandible strongly bidentated, lower simply notched; tarsi moderate; acrotarsia scutellated. Wings short; second quill longest, slightly notched near the apex.

Bengal Falcon (*Hierax cærulescens*).

"Whoever," writes Mr. Vigors, "has seen that beautiful species, the smallest of its race, *Falco cærulescens* of Linnæus, now rendered familiar to us by the accurate and splendid illustrations of Dr. Horsfield, will at once acknowledge its separation from every other established genus of the family. Its upper mandible is strongly and sharply bidentated as in *Harpagus*, but the under mandible is simply notched as in the true Falcons. Its wings, shorter than the tail, differ also from those of *Harpagus* in having the second quill-feather the longest, thus again establishing the affinity of the genus to the Falcons. The tarsi are moderate, and the acrotarsia scutellated as in the latter group of Hawks. From its thus possessing characters in common with both sub-families it is difficult to say to which we should refer it; but I prefer placing it in its present situation on account of the length of the second quill feather, a peculiarity which distinguishes the true Falcons, and gives a striking character to their flight. Placed however at the extremity of the division, it preserves its affinity with those that went before."

H. cærulescens is, according to Dr. Horsfield, the Allap or Allap-allap of the Javanese; *Falco cærulescens* of Linnæus; *F. Bengalensis* of Brisson; *Falco parvus Indicus*, 'Ger. Orn.'; Little Black and Orange



Head and foot of Bengal Falcon (*Hierax cærulescens*).

Indian Hawk of Edwards; and the Bengal Falcon of Latham. Entire length 6¼ inches. Upper parts bluish-black and glossy. Throat, breast, axillæ, sides of the neck, forehead, and a line continued from the environs of the bill over the eye and along the neck, white, with a ferruginous tail. Lower part of the breast, abdomen, vent, and thighs, ferruginous. Hypochondria, thighs posteriorly, and a broad patch extending from the eye along the side of the head, black; the plumes which cover the thighs behind are terminated by long silky filaments or radii which are straggling and pendulous, and by their laxity and irregularity afford a peculiar character to the bird. (Horsfield.) The natives told Dr. Horsfield that this small but robust bird was uncommonly bold in the pursuit of little birds. Several individuals were brought to him from the range of the southern hills, which are covered with forests, during his abode at Surakarta. He obtained one in the eastern districts. In the other parts of the Island of Java he did not observe it. Bengal is also given as its locality.

Mr. Vigors ('Zool. Proc.,' 1831) describes another species, *Ierax erythrogenys*, the size of *I. cærulescens*, from the neighbourhood of Manilla.

Falco.—Beak short; upper mandible strongly toothed; lower notched; acrotarsia reticulated; second quill longest; first and second deeply notched internally near the apex.

This genus, which includes, as Mr. Vigors observes, the greater portion of the present sub-family, comprises the typical species. "The upper mandible of this group," writes that zoologist, "is armed with a strong angular tooth; the lower is notched near the extremity. The nares are rounded. The wings are for the most part as long as the tail, the second quill-feathers being invariably the longest. The first and second quill-feathers are also distinguished by an abrupt emargination on the inner web near the extremity. In some species, as in *F. peregrinus*, the emargination of the second quill-feather is not so abrupt as in others. But in all the species of the true Falcons that have come under my examination, this emargination of the first quill-feather at least is strongly apparent. The tarsi are moderate in length and strength, and have the acrotarsia reticulated. Our European species—*F. peregrinus*, Linn.; *F. subbuteo*, Linn.; *F. Æsalon*, Linn.; *F. rufipes*, Bechstein—are readily distinguished as belonging to this typical genus. Some species belonging to the group have the wings somewhat shorter than the tail, which in conjunction with *Ierax* thus evince a gradual series of affinity between the short and long-winged tribes. Among these we may distinguish *F. tinnunculus*, Linn.; *F. rupicolus*, Daud.; with some corresponding species."

F. peregrinus, the Peregrine Falcon, is Le Faucon Pelerin of the French; Sparviere Pellegrino and Falco Reale of the Italians; Wander Falke of the Germans; Apestæ-Kæoo (Little Eagle) of the Cree Indians; Hebog Tramor and Commin of the Welsh.

Peregrine Falcon (*Falco peregrinus*).

Adult.—Length from 15 to 18 inches, depending on the sex and age of the bird. Beak blue, approaching to black at the point; cere and eyelids yellow, irides dark hazel-brown; top of the head, back of the neck, and a spot below the eye, nearly black; back and upper surface bluish-slate or ash colour, becoming lighter at every succeeding moult, the males usually the most so; feathers of back, wing-coverts, and tail, barred with a darker tint; primaries brownish black, inner webs barred and spotted with rufous white; front of neck white, with dark longitudinal lines; breast rufous white, with dark-brown transverse bars; flanks, under tail-coverts, and under surface of the tail-feathers, barred transversely with dark-brown and grayish-white; legs and toes yellow, claws black.

Young.—Head and upper surface of body and wing-coverts brownish-ash, the edge of each feather rufous; the dark longitudinal streaks on the white under-side of the body more conspicuous, but, gradually shortening and spreading laterally, they ultimately change their direction, and become transverse. This change is first observed on the belly and flanks. (Yarrell.)

Temminck considers the Lanier (Lanner) of Buffon the perfect state of the male Peregrine. He also adds *Falco Barbarus* of Latham as one of its synonyms.

The food of the Peregrine consists of land and water-fowl, rabbits, young hares, &c. It was highly prized in falconry. Tubervile, in his chapter 'Of the Haggart Falcon, and why she is called the Peregrine or Haggart,' gives the following reasons for the name:—"First, because a man cannot find, nor ever yet did any man, Christian or heathen, find their eyrie in any region; so as it may wel be thought that for that occasion they have atchieved aud gotten that name and terme of Peregrine or Haggart Falcons, as if a man would call them pilgrims or forainers. The second cause is, because these falcons do rangle and wander more then any other sort of falcons are wont to doe, seeking out more strange and uncouth countries, which indeed may give them that title of Haggart and Peregrine Hawks for theyr excellency, because they doe seeke so many strange and forraine coasts, and doe rangle so farre abroad. The third and last cause, I doe thinke, may be their beauty and excellency, because this word (Peregrino), or Peregrine, doth many times import an honourable and choice matter had in great regard. . . . Wherefore I conclude that these Haggart Falcons are not of Italie, but transported and brought thither from forraine places, as, namely, from Alexandrio, Ciprus, and Candie. And yet this is for certaine, that in Italio there are taken of these Haggart Falcons, as in the dominion of the renowned Duke of Ferrara and in the countrie near Ravenna, being brought thither by force of weather and wind. And by that means there are none of those Haggarts found Eyesses, but they are al either soare Hawks or mewed Haggarts."

"In the language of falconry," writes Yarrell, "the female Peregrine is exclusively called the Falcon, and on account of her greater size, power, and courage, is usually flown at herons and ducks; the male Peregrine, being smaller, sometimes one-third less than the female, is called the Tercel, Tiercel, and Tiercelet, and is more frequently flown at partridges, and sometimes at magpies. Young Peregrines of the year, on account of the red tinge of their plumage, aro called, tho female a Red Falcon and the male a Red Tiercel, to distinguish them from older birds, which are called Haggarts or Intermewed Hawks. Tho Lanner of Pennant is a young female Peregrine, at which age it bears some resemblance to the true Lanner, *Falco lanarius* of authors—a true Falcon also, but much more rare than the Peregrine, and which probably has never been killed in this country. Mr. Gould says he was unable to find a specimen in any collection here, either public or private, at the time he was desirous of figuring this species in his 'Birds of Europe.' The true Lanner is only found in the south and south-eastern parts of Europe. Tho king of France, Louis XVI., had Lanners sent annually from Malta; but they were brought from tho eastern countries. It exceeds the Peregrine Falcon in size, being intermediate between that and the Gyr-Falcon; was much esteemed for flying at the kite, with which the Peregrine is hardly able to contend." The name of Lanner is confined to the female; the male is called a Lanneret, on account of his smaller size. ('British Birds.') It makes its nest on high rocks. In Britain Mr. Yarrell states that the Peregrine builds on various parts of the coast, more frequently in Scotland than in England. The eggs are from two to four in number, about 2 inches long by 1 inch and 8 lines in breadth, mottled all over with pale reddish brown. Mr. Selby notices their eyrio at St. Abb's Head. It was from this locality that the late Mr. Baird of Newhyth usually obtained his cast of Hawks, for each of which he gave the persons who undertook the peril of climbing the rock one guinea. Other localities for tho nest in Britain are the cliffs between Freshwater Gate and the light-house near the Needles; Devonshire and Cornwall, where it is called Cliff-Hawk; Holyhead and the Great Orme's Head (Yarrell); rocky coast of Caernarvonshire (Pennant); rocky situations inland and marine in Ireland (Thompson quoted by Yarrell); Vale of Moffat in Dumfriesshire; the Bass Rock and the Isle of May in the Forth (Sir Wm. Jardine). It is also found in all the mountainous countries of Europe, particularly on rocks; very rare in champaign countries; never found in marshy districts; abundant in Germany and France; sufficiently common in England and Holland; rare in Switzerland (Temminck); Shetland Isles, where it breeds; Denmark, Sweden, Norway, Lapland, and Greenland (Yarrell); Uralian and Siberian mountains (Pennant). Sir John Richardson, who describes an old male from Melville Peninsula, 68° N. lat., says ('Fauna Boreali-Americana')—"The Peregrino being a raro bird in the wooded districts of the Fur Countries where tho trading posts aro established, I did not procure a specimen on the late expeditions; but I have frequently seen it whilst on the march across the Barren Grounds. Of the two specimens figured by Edwards, one was from Hudson's Bay and the other was caught off the entrance of Hudson's Straits. Sir W. E. Parry likewise brought home several male and female specimens from Melville Peninsula, some of which are preserved in the British Museum. It is a summer visitor of the northern parts of America, and frequents the coasts of Hudson's Bay and the Arctic Sea, with the Barren Grounds, but is very seldom seen in the interior. It preys habitually on the long-tailed ducks (*Anas glacialis*), which breed in great numbers in the arctic regions, arriving in June and departing in September. Sir W. E. Parry observed it, in his second voyage, following flocks of the snow-hunting on the coast of Greenland, near Cape Farewell. It frequents the shores of New Jersey and Pennsylvania in the winter, and is celebrated there for the havoc it makes among the water-fowl. Mr. Ord states that the ducks which are struck by it aro lacerated from the neck to the rump; it gives the blow in passing, and returns to pick up its bird." Port Famine, Straits of Magalhaens (Captain King); Australia (Vigors and Horsfield); Cape of Good Hope (Dr. A. Smith). Prince C. L. Bonaparte notes it as rare and as seen only in winter near Rome, and as rare and casual near Philadelphia. Dr. Smith ('South African Museum,' No. 94) says that the bird so numbered, though it does not exhibit exactly the plumage of the Peregrine Hawk of Europo, yet approaches it so closely that it might be considered as attempting too great a refinement to class it as a different species.

Mr. Vigors observes that Cuvier has separated the *Falco Islandicus* of Latham from the rest of the true Falcons, under the generic title of *Hierofalco*, which he characterises as possessing no tooth on the uppor mandible, but a rounded prominence in the centre, and in which he observes that the wings considerably fall short of the tail in length. In this opinion Mr. Vigors does not acquiesce. He cites examples of the Jerfalcon in its different stages of growth, and in none did he perceive any material difference between its bill and that of the true Falcons. He adds that he feels much hesitation in advancing the above opinion, not merely on account of the known accuracy of Cuvier, but on account of some facts that had then lately come to his knowledge. He mentions a specimen in the British Museum, in which the mandible accords exactly with Cuvier's description—"Il n'a qu'un feston commo celui des ignobles." In several specimens from the arctic regions however in the same collection, he found the tooth. After referring to the figures quoted by Cuvier, and their discrepancies, he inquires whether it may not be possible that there are two species. He cannot think that tho character itself is variable, or that Cuvier would have adopted one which must have been known to him as such, even from the plates. "In no specimen of a true falcon," says Mr. Vigors, "have I seen the slightest alteration of the tooth, except by accident."

Our limits will not permit us to do more than hint at the other species of *Falco*. *F. chicquera*, Himalaya Mountains (Gould), Deccan (Sykes), South Africa (Smith), seems to be the nearest in typical points to tho Peregrine Falcon. The following species of *Falco*, besides *F. peregrinus* and *F. chicquera*, are in tho catalogue of the South African Museum:—*F. biarmicus*, *F. rupicolus*, *F. rupicoloides*, *F. subbuteo*, and *F. Swainsonii*.

F. tinnunculus, the Kestrel, inhabits Asia and Africa, as well as Europe, and is very abundant in the Dukhun (Deccan). (Sykes; Abbott.)

4th Sub-Family, *Buteonina* (Buzzards).

Beak moderate, hooked from the base. Tail equal.

The sub-family of the Buzzards agrees, in the opinion of Mr. Vigors, with the last in the length of the wings, and the bill being bent from the base; and differs from it by a weaker and somewhat more elongated bill, by the third or fourth quill-feather being longest, and more particularly by the absence of a tooth on the upper mandible. A gradation seems however, as Mr. Vigors observes, to soften down these differences, and there is an approximation to the tooth of the Falcons in the first genus of the sub-family.

Ictinia (Vieillot).—Beak short; upper mandible subdentated, lower notched; tarsi short and weak; acrotarsia scutellated; wings long, third quill longest.

Mr. Vigors states that this genus is founded upon the Milan Cresserele of M. Vieillot, and has a strong and short bill, the upper mandible of which is somewhat angularly festooned, and the under distinctly notched. The nares aro rounded as in the Falcons; the tarsi aro rather short, and feathered below tho knees, and the acrotarsia scutellated. The wings are of considerable length, extending far beyond the tail; a character which induced M. Vieillot and others to place the bird near the Kites. Its strong affinity however to the last sub-family, of which it possesses so many of the characteristics, inclines Mr. Vigors to assign it its present situation. In manners, he adds, it seems also to approach the Falcons; and he remarks that if we consider the Mississippi Kite of Wilson to belong to the present group of Vieillot, of which Mr. Vigors has little doubt, we must attribute to the bird before us, judging from the interesting description in the 'American Ornithology,' much of those spirited and generous qualities which we admire in the typical groups of tho family.

I. plumbea (*Falco plumbeus* of Latham). Back and wings slate-blue; head and belly whitish, spotted with brown. Iris fine red.

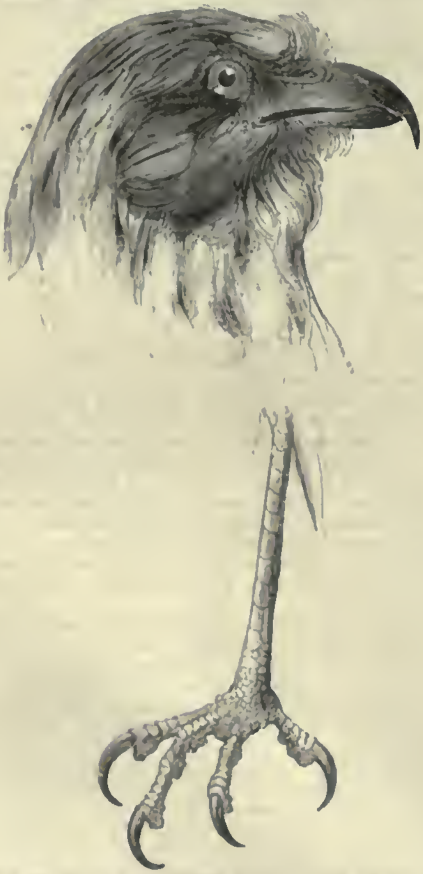
It is said to fly to a great height, where it remains a long time poised or stationary, and cleaves the air with rapidity in order to seize the great insects which are its prey, independently of reptiles and birds. It is a native of America.

Head and foot of *Ictinia plumbea.*

Circus (of Authors).—Beak moderate; nostrils sub-oval; tarsi elongated; acrotarsia scutellated; toes generally short; third quill longest; sides of the head furnished with a circle of feathers very like the capital disc of the Owls.

"This genus," says Mr. Vigors, "exhibits still a slight approximation to the last groups in the structure of the upper mandible, which has a rounded protuberance towards the middle, similar to that of the Hawks. They are distinguished from the rest of the buzzards by their elevated and slender tarsi, which are covered with feathers for some space below the knee, and of which the acrotarsia are scutellated. The nares are sub-oval and transverse on the cere, and the third quill-feathers are the longest." It includes, according to Mr. Vigors, the European species *F. æruginosus* of Aldrovandus, and *F. pygargus* of Linnæus, to which he says may be added *F. acoli* and *F. melanoleucos* of Daudin, together with some newly-described species.

C. æruginosus. This is the Harpaye, Busard Harpaye, and Busard de Marais of the French; Falco Castagnolo and Falco con la Testa



Head and foot of White-Headed Harpy (*Circus æruginosus*).

Bianca (young birds), Falco Albanella con il Collare (old), of the Italians; Schwartz-Brauner Fisch-Geyer mit dem gelben Kopf, Brauner Rohr-Geyer, Brandweihe, Wasserweihe, and Sumpfweihe, of the Germans; Moor-Buzzard, Marsh-Harrier, Duck-Hawk, Harpy, and White-Headed Harpy, of the English; and Bod y Gwerni of the Welsh.

Adult Male (third moult).—Beak bluish-black, with a slight festoon on the cutting edge; cere and irides yellow; top of the head, cheeks, and nape of the neck, yellowish-white, tinged with rufous, and streaked with dark brown; back, wing-coverts, and tertials, dark reddish-brown, with lighter margins; primaries brownish-black; secondaries and tail-feathers ash-gray.

After the third Moult.—Wing-coverts and tertials become, in addition, partially or entirely ash-gray; wing-primaries slate-gray; chin and throat nearly white; breast rufous, streaked longitudinally with dark brown; belly, thighs, and under tail-coverts, reddish-brown, each feather streaked with dark brown; legs long, slender, and yellow; toes yellow; claws sharp and black.

Second Year.—Head, neck, chin, and throat, dull yellow, with an occasional patch of the same colour on the carpus, or anterior point of the wing. (Bewick's Figure.)

Young of the Year.—All the plumage chocolate-brown; feathers tipped with lighter reddish-brown; irides darker than in the adult; legs and feet as in old birds; length from 21 to 23 inches, depending on the sex. (Yarrell.)

The Moor-Buzzard, when in pursuit of game, flies low, and will, so to speak, beat a moor or other piece of ground with the regularity almost of a well-trained pointer. Young rabbits, small quadrupeds, birds, especially water-birds, reptiles, and even fish are its prey. Sometimes it will sit on the look-out on a stone or low bush. It builds its nest generally on the ground, in a tuft of rushes or coarse grass or furze, and composed of rushes or rank grass, and small sticks. Latham says that it will sometimes build its nest in the fork of a large tree, but that the instance is rare. Eggs, three or four, oval, rather pointed at one end, 2 inches and 1 line in length, by 1 inch 6 lines in breadth. (Yarrell.)

It is found in Denmark, Norway, Sweden, south of Russia, Germany, France, Holland, Spain, Italy, and Turkey; in all countries where there are marshes; very abundant in Holland; rare in the south, migratory in the autumn (Temminck); common in the marshes near Rome, but only young birds, and migratory (Bonaparte); Trebizond (Abbott); Ganges, between Calcutta and Benares, &c. (James Franklin); Europe, India, Africa (Gould); Smyrna (Strickland).

The Moor-Buzzard may be seen in most parts of England and Wales favourable to its habits. It occurs in Scotland and the Hebrides, and Mr. Thompson notes it as existing in several counties of Ireland from Cork to Antrim.

Mr. Vigors observes that the sub-family of Buzzards is that which of all the *Falconidæ* approaches nearest to the family of the Owls (*Strigidæ*). In their dull and slothful habits, their heavy flight, and indeed their whole appearance, these contiguous groups evince, he remarks, a general resemblance, indicating a corresponding inferiority in the qualities which distinguish the birds of prey. The soft and loose texture of the plumage of both presents a similar affinity, and he adds that *Circus*, in particular, furnishes us with a still further and more intimate point of resemblance. The feathers that cover the cheeks and ears form, as he says, a sort of rounded collar that rises on each side of the face; thus exhibiting a conformity to the disc or circular erection of the face-feathers so conspicuous in the Owls.

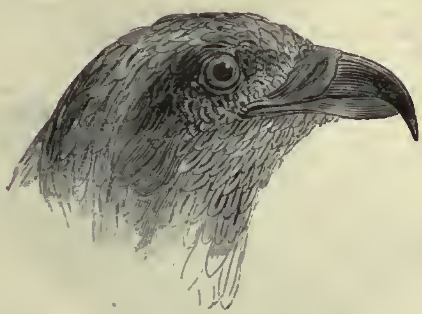
Speaking of *C. cyaneus*, the Hen-Harrier, Mr. Gould, in noticing the Trebizond collection of birds presented to the Zoological Society by Mr. Keith Abbott, says that European, African, Indian, Chinese, and North American specimens present no specific difference. *C. cineraceus* he notes as European, Indian, and African. ('Zool. Proc.,' 1834.) In the South African Museum will be found *C. ranivorus* (with habits very much resembling those of our Moor-Buzzard), *C. Maurus*, *C. Swainsonii*, and *C. Vaillantii*. In the British Museum there is a very good series of the Moor-Buzzard, illustrating the different changes of plumage.

Pernis (Cuvier).—Beak moderate; lore covered with serrated feathers; tarsi moderate, semi-plumed; acrotarsia reticulated; third quill longest.

Mr. Vigors observes that *Pernis* is distinguished by the singular character of the lorum that surrounds the eye, being covered with feathers, instead of being naked as in the other *Falconidæ*, or furnished only with hairs. In other respects also, he states, the genus differs from that of *Buteo* which follows. Its acrotarsia are reticulated, and, like *Circus*, it has the third quill the longest. The nares are similar to those of *Buteo*. *Falco apivorous* of Linnæus, the Honey-Buzzard, and a corresponding species from Java, *P. ptilorhynchus* of Temminck, form, he adds, the typical species of the genus.

P. apivorus, the Honey-Buzzard. It is La Bondrée and Buse Bondrée of the French; Wespen-Busard of the Germans; Frosch-Geyer of Kramer; Stag-Hok of the 'Fauna Suecica;' Muse-Haeg and Muse Baage of Brunnich; and Bod y Mel of the Welsh.

Old Male.—Space between the eye and the beak covered with small serried feathers. Top of the head very pure ashy-blue; upper parts of the body brown, more or less ashy; secondaries barred alternately with blackish-blue and gray-blue; tail with three bands of blackish-brown, at unequal distances; throat yellowish-white, with brown spots; neck and belly marked with triangular brown spots on a whitish ground; cere deep ash; interior of beak, iris, and feet, yellow. Length about two feet.



Head and foot of Honey-Buzzard (*Pernis apivorus*).

Female and Young.—Ashy-blue on the forehead only; front of the neck marked with great spots of bright brown; breast and belly yellowish-red with deeper spots; under surface of the body often whitish, with reddish-brown spots.

Young of the Year.—Cere yellow; iris bright brown; head spotted with white and brown; under part of the body reddish-white, with great brown spots; feathers of the upper parts bordered with reddish. (Temminck.)

The Honey-Buzzard feeds on field-mice, moles, mice, hamsters, birds, reptiles, wasps, and other insects. (Temminck.) "Examinations," says Mr. Yarrell in his 'British Birds,' "have usually proved the food to have been the larvæ of bees and wasps, to obtain which the receptacles containing them are scratched out and broken up in the manner described by Sir William Jardine. In one instance, in the case of a honey-buzzard kept in confinement, I was told that it killed and ate rats, as well as birds of considerable size, with great ease and good appetite." The same author records that the stomach of a specimen killed in the north of Ireland and examined by Mr. Thompson of Belfast, contained a few of the larvæ and some fragments of perfect coleopterous insects; several whitish-coloured hairy cater pillars; the pupæ of a species of butterfly, and also of the six-spot hornet-moth. Willughby says, "In the stomach and guts of that we dissected we found a huge number of green caterpillars of that sort called *Geometræ*, many also of the common green caterpillars and others." White's specimen had in its stomach limbs of frogs, and many gray snails without shells. Willughby says that it runs very swiftly like a hen. Vieillot states that it seldom flies, except from one tree to another, or from bush to bush, and then always low, and that it runs on the ground with great rapidity like the common fowls. Nest on a lofty tree in a wood or forest. White mentions one on a tall slender beech near the middle of Selborne Hanger. Willughby says, "It builds its nest of small twigs, laying upon them wool, and upon the wool its eggs. We saw one that made use of an old kite's nest to breed in, and that fed its young with the nymphæ of wasps; for in the nest we found the combs of wasps' nests, and in the stomachs of the young the limbs and fragments of wasp-maggots. There were in the nest only two young ones, covered with white down spotted with black. Their feet were of a pale yellow, their bills between the nostrils and the head white; their craws large, in which were lizards, frogs, &c. In the crop of one of them we found two lizards entire, with their heads lying towards the bird's mouth, as if they sought to creep out." The same author says that the eggs are cinereous, marked with darker spots. The egg mentioned by White was smaller and not so round as those of the common Buzzard, dotted at each end with small red spots, and surrounded in the middle with a broad blood-red zone. Pennant mentions two blotched over with two shades of red, somewhat darker than those of the Kestrel. "The eggs of the Honey-Buzzard," writes Mr. Yarrell, "are rare; I have only seen three or four specimens, one of which answered to the description given by White, the colouring-matter being confined to a broad band round the middle. One specimen in my collection resembles those mentioned by Pennant, being mottled nearly all over with two shades of orange-brown: long diameter 2 inches 1 line; transverse diameter 1 inch 9 lines."

This bird is found in oriental countries; it is very rare and accidental in Holland; more abundant in France in the Vosges and in the south, a bird of passage (Temminck). Denmark, Norway, Sweden, Russia, Germany, France, Italy, and the south of Europe generally (Yarrell and authors by him quoted). Skins received from India (Gould). In Britain the bird has been obtained in Suffolk, Norfolk, and along the eastern coast as far north as Northumberland, and in several western counties, including Dorsetshire, Devonshire, and Worcestershire. Rare in Cumberland, according to Dr. Heysham, who had only met with one specimen, and was told that it bred in the woods at Lowther. Mr. Thompson mentions one killed in the north of Ireland, and Mr. Macgillivray two as having occurred in Scotland. Buffon and others, Belon among the rest, say that it gets very fat in winter and is then good eating.

Buteo (of Authors).—Beak moderate, rather weak; nostrils somewhat rounded; tarsi short; acrotarsia scutellated; fourth quill longest.

Mr. Vigors remarks that the true Buzzards are known by their comparatively feeble bill, their short tarsi, and scutellated acrotarsia. Their nares are round and their fourth quill-feather the longest. Their tarsi are either plumed to the toes or half way covered with feathers. Of those whose tarsi are completely feathered, *F. lagopus* of Linnæus is the type, according to Mr. Vigors, and *F. desertorum* of Daudin appears to appertain to it; of those birds whose tarsi are but half plumed he gives *Buteo vulgaris*, the Common Buzzard, as an example, and remarks that the genus is very numerous in species, and that the form is very generally to be observed over the globe.

B. vulgaris, *Falco Buteo* of Linnæus; *Buteo* of Gesner; *Falco variegatus* of Gmelin; *F. glaucopis* of Merrem; La Buse of the French; Falco Bottaone and Pojana of the Italians; Mause-Falk and Wald-Geyer of the Germans; Quidfogel of the 'Fauna Suecica;' Oerne Falk of Brunnich; and Bod Teircaill of the Welsh. "The whole length of the Common Buzzard is from 20 to 22 inches, depending on the sex—the females, as in the *Falconidæ* generally, being the largest. From the habit of seeking food late in the evening, observed in this species, and also in the Rough-Legged Buzzard, and in the softer and more downy texture of the feathers, as compared with the plumage of the true Falcons, the Buzzards are considered as indicating an approach to the Owls. The beak is bluish-black, darkest in colour towards the point; the cere yellow; the irides generally yellow; but, as the Common Buzzard and indeed all the Buzzards are subject to considerable variation in the colour of their plumage, the irides are observed to vary also, presenting some reference to the prevailing

Common Buzzard (*Buteo vulgaris*).

tone of the colour of the feathers. The upper part of the head, occiput, and cheeks, pale-brown, streaked longitudinally with darker brown; the whole of the back, wing-coverts, upper tail-coverts, and upper surface of the tail-feathers, dark clove-brown, the latter barred with lighter brown, the feathers of the former-named parts having lighter-coloured edges; the wing-primaries brownish-black; the chin and throat almost white; front of the neck, breast, under wing-coverts, belly, and thighs, grayish-white, barred transversely with dark wood-brown; legs and toes yellow; the claws black." (Yarrell.)

The following are varieties:—*Falco albidus*, Gmel.; *F. versicolor*, Gmel.; Weisslicher Busard, Borkh. 'Deut. Orn.' (Temminck.)

The flight of the Buzzard is slow, and it generally remains perched on some tree in the wooded districts patiently waiting for its prey, namely, small quadrupeds, birds, and reptiles, and even earth-worms and insects. It may be seen sometimes soaring in circles, but not often, and does not pursue its game, but pounces at it when on the ground. Its nature is slothful and cowardly, but its philoprogenitiveness appears to be great. The Cock Buzzard will hatch and bring up the young if the hen is killed (Ray), and among other instances Mr. Yarrell records one of a female buzzard kept in the garden of the Chequers Inn, at Uxbridge, which showing an inclination a few years back to make a nest and sit, was supplied with materials and two hen's eggs, which she hatched and afterwards reared the chicks. Since that time she has hatched and brought up a brood of chickens every year. Once they put down chicks just hatched to her to save her the labour of sitting, but she killed them all. Her family, says Mr. Yarrell, in June 1831, consisted of nine; the original number were ten, but one had been lost. When flesh was given her she was very assiduous in tearing and offering it as food for her nurslings, and appeared uneasy if, after taking small portions from her, they turned away to pick up grain. ('British Birds,' where there is an elegant vignette of the bird and her foster family.) Indeed the young remain with the old birds some little time after they quit the nest, contrary to the usage of other birds of prey, which generally drive away their young as soon as they can fly. In Scotland, where the bird is said to be bolder, on rocks or on the edges of steep scars or beds of torrents. (Macgillivray.) In England the Buzzard builds (or sometimes takes to a nest) in the fork of a tree in a wood. The eggs are generally three, sometimes four, short oval, 2 inches 3 lines in length by 1 inch 10 lines in breadth, of a solid white, slightly spotted with pale-brown. (Yarrell.)

The Buzzard is common in all the wooded countries of Europe. Very abundant in Holland. (Temminck.) It is well-known, says Mr. Yarrell, over the wooded parts of the continent of Europe, south of Russia, and inhabits Spain and Italy, passing over the Mediterranean to North Africa: but Trebizond, Smyrna, and Madeira, appear to be its limits to the southward. Prince Bonaparte notes it as very common near Rome. In several parts of Ireland it is common (Thompson); not very plentiful in Scotland, nor does it appear in the lists of the birds of Orkney and Shetland, by the Rev. Mr. Low and Mr. Dunn, though it occurs in Denmark, Norway, Sweden, and Russia. Mr. Gould, in noticing the Trebizond birds presented to the Zool. Soc. by Mr. Keith Abbott, among which it was, observes that it was not previously observed in Asia, although there is a nearly allied species in the Himalaya Mountains, and that it had not then been noticed in Africa. ('Zool. Proc.,' 1834.) In England, though lately more rare, it is still far from uncommon.

Sir John Richardson ('Fauna Boreali-Americana') states that the Common Buzzard arrives in the Fur Countries in the middle of April, very soon afterwards begins to build its nest, and, having reared its young, departs about the end of September. It haunts the low alluvial points of land which stretch out under the high banks of a river, and may be observed for a long time motionless on the bough of a tree watching for some small quadruped, bird, or reptile to pass within its reach. As soon as it espies its prey, it glides silently into the air, and sweeping easily but rapidly down seizes it in its claws. When disturbed, it makes a short circuit, and soon settles on another perch. One of Sir John's specimens had two middle-sized toads in its crop. It builds its nest, he says, on a tree, of short sticks, lining it with deer's hair. The eggs are from three to five in number, and he remarks that it was seen by the expedition as far north as the 57th parallel, and that it most probably has a still higher range. He gives a description of two; one a male, shot on the 17th June at the nest, which contained three eggs, on the plains of the Saskatchewan; and another, a female, killed at the nest also, near Carlton, May 22.

Buteo Bacha is recorded by Major James Franklin among the collection formed by him on the banks of the Ganges and in the mountain chain of Upper Hindustan. In the South African Museum the *B. Jackal* and *B. Tachardus* are preserved. The former obtains its name from uttering a cry somewhat similar to that of the small quadrupeds called Jackals at the Cape. It abounds throughout South Africa. In the same collection will be found *Butaëtes Lessonii.*

5th Sub-Family, *Milvina* (Kites).

Beak moderate, rather hooked from the base. Tail forked. The length of the wings and the forked tail, instruments of action to which the birds are indebted for their peculiar power and gracefulness of flight, are the characters which more particularly separate the Kites from the rest of the *Raptores*.

Elanus (Savigny).—Beak moderate, weak, compressed; tarsi short, semiplumed; acrotarsia reticulated; claws, with the exception of the middle one, rounded internally; second quill longest; first and second quills strongly notched internally.

E. melanopterus, the Black-Winged Swallow-Hawk. This is the *Falco melanopterus* of Daudin; *E. cæsius* of Savigny; and Le Blac of Le Vaillant. Size of a Sparrow-Hawk. Plumage soft and silky; tail a little forked. Above ash-coloured, quills blackish, beak and shoulders black. Below white. Tail principally white. Feet yellow.

Black-Winged Swallow-Hawk (*Elanus melanopterus*).

The bird is said to live principally upon insects, which it captures on the wing. It is common in Africa from Egypt to the Cape. There is a specimen in the South African Museum. Savigny speaks of it as being in great abundance in Syria, Egypt, and Barbary. Cranch (Tuckey's Expedition) saw great numbers at the mouth of the Congo, and some were sent home from thence. Lesson says that it occurs in Australia. It is noticed among the birds collected by Major James Franklin on the banks of the Ganges, and in the mountain-chain of Upper Hindustan.

Nauclerus (Vigors).—Beak rather short, weak, compressed; nostrils sub-oval, placed in the cere, which is furnished with bristles in an oblique direction; wings long, second or third quill longest; tail long, very much forked; feet short, weak; tarsi reticulated; acrotarsia feathered below the knee to the middle; claws not cylindrical; body slender, elegant.

Mr. Vigors observes that *Nauclerus* is distinguished from the true *Milvus* by the greater development of the character of the forked tail; by the relative proportion of the wing-feathers, the fourth being the longest in *Milvus;* and by the reticulation of the acrotarsia, those of *Milvus* being covered with even scales or scutellated. He divides the genus into two sections.

1st. With the second quill longest.

N. Riocourii may be given as an example.

2nd. With the third quill longest.

N. furcatus (*Falco furcatus*, Linn.), the Swallow-Tailed Hawk.

Whole length 20 inches; beak bluish-black, cere lighter blue, irides dark; head, neck, breast, belly, under surface of the wings, sides of the body, thighs, and under tail-coverts, pure white; back, wing-primaries, secondaries, upper tail-coverts, and tail-feathers, black, with a purplish metallic lustre; tertials black on the outer webs, but patched with pure white on the inner; tail very deeply forked; legs and toes greenish-blue; claws faded orange. (Yarrell.)

We select Mr. Audubon's account of the habits and locality of this graceful bird:—"A solitary individual of this species has once or twice been seen in Pennsylvania. Farther to the eastward the Swallow-Tailed Hawk has never, I believe, been observed. Travelling southward along the Atlantic coast, we find it in Virginia, although in very small numbers. Beyond that state it becomes more abundant. Near the falls of the Ohio a pair had a nest, and reared four young ones in 1820. In the lower parts of Kentucky it begins to become more numerous; but in the states farther to the south, and particularly in parts near the sea, it is abundant. In the large prairies of the Attacapas and Oppellousas it is extremely common. In the states of Louisiana and Mississippi where these birds are abundant, they arrive in large companies in the beginning of April, and are heard uttering a sharp plaintive note. At this period I generally remarked that they came from the westward, and have counted upwards of a hundred in the space of an hour, passing over me in a direct easterly course. At that season and in the beginning of September, when they all retire from the United States, they are easily approached when they have alighted, being then apparently fatigued, and busily engaged in preparing themselves for continuing their journey, by dressing and oiling their feathers. At all other times however it is extremely difficult to get near them, as they are generally on wing through the day, and at night rest on the higher pines and cypresses, bordering the river bluffs, the lakes, or the swamps of that district of country. They always feed on the wing. In calm and warm weather they soar to an immense height, pursuing the large insects called Musquito-Hawks, and performing the most singular evolutions that can be conceived, using their tail with an elegance of motion peculiar to themselves. Their principal food however is large grass-hoppers, grass-caterpillars, small snakes, lizards, and frogs. They sweep close over the fields, sometimes seeming to alight for a moment to secure a snake, and holding it fast by the neck, carry it off and devour it in the air. When searching for grasshoppers and caterpillars, it is not difficult to approach them under cover of a fence or tree. When one is then killed and falls to the ground, the whole flock come over the dead bird, as if intent upon carrying it off. An excellent opportunity is thus afforded of shooting as many as may be wanted, and I have killed several of these hawks in this manner, firing as fast as I could load my gun. The Swallow-Tailed Hawk pairs immediately after its arrival in the southern states; and as its courtships take place on the wing, its motions are then more beautiful than ever. The nest is usually placed on the top branches of the tallest oak or pine tree, situated on the margin of a stream or pond. It resembles that of a carrion crow externally, being formed of dry sticks, intermixed with Spanish moss, and is lined with coarse grasses and a few feathers. The eggs are from four to six, of a greenish-white colour, with a few irregular blotches of dark brown at the larger end. The male and female sit alternately, the one feeding the other. The young are at first covered with buff-coloured down. Their next covering exhibits the pure white and black of the old birds, but without any of the glossy purplish tints of the latter. The tail, which at first is but slightly forked, becomes more so in a few weeks, and at the approach of autumn exhibits little difference from that of the adult birds. The plumage is completed the first spring. Only one brood is raised in the season. The species leaves the United States in the beginning of September, moving off in flocks, which are formed immediately after the breeding season is over."

The Swallow-Tailed Hawk (*Nauclerus furcatus*).

This species, according to Mr. Nuttall, will, like the Honey-Buzzard, prey upon locusts and wasps and their larvæ, and make a regular attack on their nests. M. Vieillot states that it visits Peru and Buenos Ayres. Mr. Yarrell gives it a place among the British birds on the authority of two specimens, one killed at Balachoalist in Argyleshire in 1772, and another taken alive in Shaw-Gill, near Hawes in Wensleydale, Yorkshire, in 1805. Apparently to avoid the violence of a tremendous thunder-storm and the clamorous persecution of a flock of rooks which attacked it at the same instant, on the 6th of September, it took shelter in a thicket, where it was seized before it could extricate itself. The person who caught it kept it a month; but a door being accidentally left open, it made its escape. It first alighted on a tree at no great distance, from which it soon ascended in a spiral flight to a great elevation, and then went steadily off in a southerly direction as far as the eye could trace it. ('Linn. Trans.,' vol. xiv.)

Milvus (of authors).—Beak moderate, weak, subangular above; nostrils oblique, elliptical; tarsi short; acrotarsia scutellated; wings very long, fourth quill longest; tail forked.

M. ictinus, Falco Milvus of Linnæus; *M. vulgaris* of Fleming and Gould.

This is the Milan Royal of the French from Belon to Buffon; Pojana, Milvio, Nicchio, and Nibbio, of the Italians; Rother-Milan of the Germans; Glenta of Brunnich; Glada of the 'Fauna Suecica;' Kite, Fork-Tailed Kite, Glead, or Glede (Pennant says from the Saxon 'Glida'), of the English; and Barcud of the Welsh. In some of the counties of England it is called the Puttock, a name also sometimes bestowed provincially upon the Common Buzzard. In Essex it is called the Crotched-Tailed Puddock.

Length about 26 inches; beak horn-colour; cere and irides yellow; feathers of the head and neck grayish-white, streaked along the shaft with ash-brown; feathers of the back and wing-coverts dark brown in the centre, broadly edged with rufous; inner web of some of the tertials edged with white; primaries nearly black; upper tail-coverts rufous; tail-feathers reddish-brown, the outer webs of one uniform colour, the inner webs barred with dark brown; the outer tail-feather on each side the darkest in colour; tail deeply forked; chin and throat grayish-white, streaked with dusky; breast, belly, and thighs, rufous-brown, each feather with a central longitudinal streak of dark brown; under surface of the wings near the body rufous, with dark brown feathers edged with red-brown towards the outer part of the wing; under tail-coverts plain rufous-white; under surface of the tail-feathers grayish-white, with the dark bars of the upper surface showing through; tarsi and toes yellow; claws black. (Yarrell.) The females are larger than the males.

Kite (*Milvus ictinus*).

The Kite sails gracefully in the air, now describing circles, and anon with outspread tail remaining stationary. It pounces on its prey, consisting of moles, mice, leverets, rabbits, unfledged birds, and the young of the Gallinaceous tribe especially. It was, when more plentiful than it is at present, a great scourge to the poultry-yard. It will eat frogs and snakes; and in the 'Magazine of Natural History' an observer bears witness to its taking fish from a broad river near which he resided. The nest, made of sticks and lined with soft materials, is usually built on the fork of a tree in a thick wood. The eggs are two, sometimes three, short oval, 2 inches 2 lines in length by 1 inch 9 lines in breadth. They are of a dirty white, with a few reddish-brown spots at the large end. The female lays early in the season, and she often makes a vigorous defence when her nest is attacked.

The Kite is found in France, Italy, Switzerland, and Germany; less abundant in Russia; more rare in Holland; migratory in autumn. (Temminck.) Very common near Rome, especially near the herds of cattle. (Bonaparte.) It also occurs in Siberia, and the country about Lake Baikal; and has been observed in Egypt, and several parts of Africa north of the equator. In Ireland it does not seem to be known. In Britain, especially in the southern counties, it is become rare, though at one time it was evidently abundant. Clusius states that when he was in London an amazing number of Kites flocked there for the offals which were thrown into the streets. They were so tame that they took their prey in the midst of crowds, and it was forbidden to kill them. In falconry it was used both as pursuer and pursued, and is very docile. Louis XVI. flew at the Kite with powerful falcons; and Sir John Sebright tells us that "Fork-Tailed Kites were much flown some years ago by the Earl of Orford in the neighbourhood of Alconbury Hill. A great owl, to the leg of which the falconers usually tie a fox's brush, not only to impede its flight, but to make it, as they fancy, more attractive, is thrown up to draw down the Kite."

Colonel Sykes notes *Milvus govinda* as occurring both in South Africa and India. In the catalogue of the South African Museum is the following account of *Milvus parasiticus*, the Cape Kite, there preserved:—"This bird is the Kuicken Deif, or Chicken-Stealer of the Dutch colonists, and only appears in South Africa during the summer season. It resorts to inhabited places, and as its name implies, is very destructive to young chickens. Everywhere it is bold; but it is especially so in districts into which fire-arms have not as yet been introduced, where it will pounce down and seize pieces of flesh from the hands of children, or even grown persons. It feeds in part upon carrion, and many individuals are often seen congregated together upon dead carcases."

General Geographical Distribution of the *Falconidæ*.—Wherever birds and small quadrupeds are to be found, there is the bird of prey, whose office it is to keep their number within their proper bounds. Thus as Mr. Vigors writes ('Zool. Journ.,' vol. i. p. 329—'On the Groups of the Falconidæ'), there seem to be no limits affixed to the geographical distribution of the true Falcons. This indeed appears generally the case in the larger groups of this family. The Naked-Cheeked *Falconidæ* alone seem to be confined to the southern parts of the New World, and to Australia, if we are to refer *F. Novæ Zælandiæ* of Dr. Latham to the genus *Polyborus*, according to M. Temminck's opinion. But the remaining groups appear to be dispersed in every division of the globe.

The *Falconidæ* described and figured in Mr. Swainson's 'Birds of Western Africa,' before alluded to, belong to the two most typical or perfect divisions of the family, namely, the Noble Falcons (*Falconidæ*), and the Hawks (*Accipitrinæ*).

Some of the best illustrations of the *Falconidæ* will be found in Audubon, Bewick, Gould, Le Vaillant, Temminck, Savigny, Swainson, Vieillot, and Yarrell. Some of Frisch's figures are good. There are many fine and expensive works (the 'Planches Enluminées,' for example), which contain figures of these noble birds, but they are sadly deficient in character, and look like what they were mostly taken from—ill-stuffed specimens. There is more to be learnt from the wood-cuts of the heads by Swainson in 'Fauna Boreali-Americana' and the 'Classification of Birds,' than from the most gorgeously coloured ill-shaped engraving. The magnificent works of Audubon and Gould are full of the character of the respective species: Swainson particularly excels in this, whether he portrays the bird in his beautiful drawings, or gives an epitome of its leading points in the small compass of a wood-cut. The figures in Yarrell's 'British Birds' are excellent, and charming examples of the perfection to which wood engraving can be carried.

The following is an arrangement of the species of *Falconidæ* specimens of which are to be seen in the British Museum:—

Family FALCONIDÆ.
Sub-Family I. *Aquilinæ*.
I. *Aquila*.
a. *Aquila*.
1. *A. chrysaëtos*, the Golden Eagle.
2. *A. Mogilnik*, the Imperial Eagle.
3. *A. nævia*, the Rough-Footed Eagle.
4. *A. nævioides*, the Tawny Eagle.
5. *A. Bonellii*, Bonelli's Eagle.
b. *Uroaëtus*.
6. *A. audax*, the Bold Eagle.
c. *Pteroaëtus*.
7. *A. vulturina*, the Vulturine Eagle.
d. *Hieraëtus*.
8. *A. pennata*, the Booted Eagle.
e. *Heteropus*.
9. *A. Malayensis*, Reinwardt's Eagle.
II. *Spizaëtus*.
a. *Spizaëtus*.
1. *S. ornatus*, the Crested Goshawk.
2. *S. bellicosus*, the Martial Eagle.
3. *S. coronatus*, the Crowned Eagle.
b. *Spizastur*.
4. *S. melanoleucus*, the Black and White Eagle.
c. *Lophaëtus*.
5. *S. occipitalis*, the Occipital Eagle.
d. *Pterura*.
6. *S. Tyrannus*, the Tyrant Eagle.
e. *Lymnaëtus*.
7. *S. cirrhatus*, the Crested Indian Eagle.
8. *S. Borneonensis*, the Crested Borneau Eagle.
III. *Herpetotheres*.
1. *H. cachinnans*, the Laughing Falcon.
IV. *Circaëtus*.
a. *Circaëtus*.
1. *C. Gallicus*, the Jean-le-Blanc Eagle.
2. *C. thoracicus*, the Black-Breasted Eagle.
3. *C. fasciolatus*, the Banded Falcon.
b. *Spilornis*.
4. *C. Bacha*, the Bacha Eagle.
5. *C. Cheela*, the Cheela Eagle.
6. *C. Holospilus*, the Spotted Bacha.
c. *Harpyhaliaëtus*.
7. *C. coronatus*, the Crowned Eagle.
V. *Thrasaëtus*.
1. *T. Harpyia*, the Crested Eagle.
VI. *Morphnus*.
1. *M. Guianensis*, the Guyana Goshawk.
2. *M. Urubitinga*, the Brazilian Eagle.
3. *M. meridionalis*, the Rufous-Headed Falcon.
VII. *Pandion*.
a. *Pandion*.
1. *P. Haliaëtus*, the Osprey.
2. *P. leucocephalus*, the White-Headed Osprey.
b. *Polioaëtus*.
3. *P. Ichthyaëtus*, the Marine Eagle.
4. *P. humilis*, the Small Marine Eagle.
VIII. *Cuncuma*.
a. *Cuncuma*.
1. *C. Macei*, Mace's Eagle.
2. *C. leucogaster*, the White-Bellied Eagle.
3. *C. vocifer*, the Piscivorous Eagle.
b. *Geranoaëtus*.
4. *C. melanoleucus*, the Black and White Eagle.
IX. *Haliaëtus*.
1. *H. albicilla*, the Cinereous Eagle.
2. *H. leucocephalus*, the Bald Eagle.
X. *Helotarsus*.
1. *H. ecaudatus*, the Short-Tailed Eagle.
XI. *Haliastur*.
1. *H. Indus*, the Pondicherry Eagle.
2. *H. leucosternus*, the White-Headed Rufous Eagle.
3. *H. Sphenurus*, the Whistling Hawk.
Sub-Family II. *Polyborinæ*.
I. *Ibycter*.
1. *I. Americanus*, the Red-Throated Falcon.
2. *I. ater*, the Black Caracara.
II. *Milvago*.
a. *Milvago*.
1. *M. chimachima*, the Chimachima Falcon.
2. *M. chimango*, the Chimango Caracara.
b. *Phalcobaënus*.
3. *M. megalopterus*, the Long-Winged Caracara.
c. *Aëtotriorchis*.
4. *M. australis*, the Southern Caracara.
III. *Polyborus*.
1. *P. Brasiliensis*, the Brazilian Kite.
Sub-Family III. *Buteoninæ*.
I. *Buteo*.
a. *Buteo*.
1. *B. vulgaris*, the Common Buzzard.
2. *B. Tachardus*, the African Buzzard.
3. *B. rufinus*, the Long-Legged Buzzard.
4. *B. Jackal*, the Jackal Falcon.
5. *B. augur*, the North African Buzzard.
6. *B. plumipes*, the Half-Booted Buzzard.
b. *Pœcilopterius*.
7. *B. borealis*, the American Buzzard.
8. *B. lineatus*, the Barred-Breasted Buzzard.
9. *B. Pennsylvanicus*, the Broad-Winged Falcon.
c. *Tachytriorchus*.
10. *B. erythronotus*, the Red-Backed Buzzard.
11. *B. pterocles*, the Banded-Sided Hawk.
12. *B. albonotatus*, the White-Spotted Buzzard.
13. *B. leucops*, the White-Faced Buzzard.
d. *Buteogallus*.
14. *B. æquinoctialis*, the Equinoctial Eagle.
15. *B. nigricollis*, the Pamena Eagle.
e. *Leucopterius*.
16. *B. melanops*, the Streaked Falcon.
17. *B. albicollis*, the White-Necked Falcon.
18. *B. scotopterus*, the Brazilian Buzzard.
19. *B. polionotus*, the Gray-Backed Buzzard.
II. *Archibuteo*.
1. *A. Lagopus*, the Rough-Legged Falcon.
2. *A. Sancti Johannis*, the St. John's Eagle.

3. *A. ferrugineus*, the Cacique Buzzard.
4. *A. strophiatus*, the White-Breasted Buzzard.

Sub-Family IV. *Milvinæ.*

I. *Baza.*

a. *Aviceda.*

1. *B. cuculoïdes*, the African Baza.

b. *Baza.*

2. *B. lophotes*, the Cohy Falcon.
3. *B. subcristata*, the Small-Crested Baza.
4. *B. magnirostris*, the Large-Billed Baza.

II. *Pernis.*

1. *P. apivorus*, the Honey-Buzzard.
2. *P. cristata*, the Crested Honey-Buzzard.

III. *Milvus.*

a. *Milvus.*

1. *M. regalis*, the Kite.

b. *Hydroictinia.*

2. *M. Govinda*, the Govinda Kite.
3. *M. niger*, the Black Kite.
4. *M. affinis*, the Australian Kite.
5. *M. Ægyptius*, the Arabian Kite.

IV. *Elanoïdes.*

a. *Elanoïdes.*

1. *E. furcatus*, the Swallow-Tailed Falcon.

b. *Chelidopteryx.*

2. *E. Riocouri*, the Riocouris Falcon.

V. *Elanus.*

1. *E. melanopterus*, the Black-Winged Falcon.
2. *E. axillaris*, the Axillary Falcon.
3. *E. scriptus*, the Letter-Winged Falcon.
4. *E. leucurus*, the White-Tailed Hawk.

VI. *Gampsonyx.*

1. *G. Swainsoni*, Falcon-like Hawk.

VII. *Rostrhamus.*

1. *R. sociabilis*, the Hook-Billed Falcon.

VIII. *Cymindis.*

a. *Cymindis.*

1. *C. Cayanensis*, the Cayenne Falcon.

b. *Regerhinus.*

2. *C. uncinatus*, the Crook-Billed Falcon.

IX. *Ictinia.*

a. *Ictinia.*

1. *I. Mississippensis*, the Mississippi Kite.

b. *Pœcilopteryx.*

2. *I. plumbea*, the Spotted-Tailed Hobby.

Sub-Family V. *Falconinæ.*

I. *Falco.*

a. *Hierofalco.*

1. *F. Gyrfalco*, the Jerfalcon.
2. *F. subniger*, the Black Falcon.
3. *F. peregrinator*, the Sultan Falcon.
4. *F. peregrinus*, the Peregrine Falcon.
5. (?) *F. melanogenys*, the Black-Cheeked Falcon.
6. (?) *F. anatum*, the Duck Falcon.
7. *F. peregrinoïdes*, the Salakoo Falcon.

b. *Gennaia.*

8. *F. cervialis*, the Double-Bearded Falcon.
9. *F. lanarius*, the Lanner Falcon.
10. *F. Jugger*, the Jugger Falcon.

II. *Hypotriorchis.*

a. *Hypotriorchis.*

1. *H. subbuteo*, the Hobby Falcon.
2. *H. severus*, the Severe Falcon.
3. *H. rufigularis*, the Red-Necked Falcon.
4. *H. frontatus*, the Paramatta Falcon.

b. *Æsalon.*

5. *H. concolor*, the Uniform Falcon.
6. *H. Æsalon*, the Merlin.
7. *H. columbarius*, the Pigeon-Hawk.
8. *H. Chicquera*, the Chicquera Falcon.
9. *H. femoralis*, the Red-Thighed Hawk.

III. *Ieracidea.*

1. *I. berigora*, the Cream-Bellied Falcon.
2. *I. Novæ Zealandiæ*, the New Zealand Falcon.

IV. *Tinnunculus.*

a. *Tinnunculus.*

1. *T. alaudarius*, the Kestril Falcon.
2. *T. rupicolus*, the Rufous-Backed Kestril.
3. *T. rupicoloïdes*, the Rock-Falcon.
4. *T. punctatus*, the Spotted Falcon.

b. *Tichornis.*

5. *T. cenchris*, the Lesser Kestril.
6. *T. cenchroïdes*, the Nankin Hawk.

c. *Erythropus.*

7. *T. vespertinus*, the Ingrian Falcon.

d. *Pœcilornis.*

8. *T. sparverius*, the Little Falcon.
9. (?) *T. cinnamomeus*, the Cinnamon Falcon.

V. *Harpagus.*

1. *H. diodon*, the Two-Toothed Falcon.
2. *H. bidentatus*, the Notched Falcon.

VI. *Ierax.*

1. *I. cærulescens*, the Bengal Falcon.
2. *I. Eutolmus*, the White-Naped Falcon.
3. *I. sericeus*, the Silky-Falcon.

Sub-Family VI. *Accipitrinæ.*

I. *Astur.*

a. *Astur.*

1. *A. palumbarius*, the Goshawk.
2. *A. melanoleucus*, the Pied Goshawk.
3. *A. radiatus*, the Radiated Falcon.

b. *Spizageranus.*

4. *A. unicinctus*, the One-Banded Hawk.

c. *Leucospiza.*

5. *A. Novæ Hollandiæ*, the New Holland White Eagle.

d. *Lophospiza.*

6. *A. trivirgatus*, the Three-Streaked Hawk.

e. *Asturina.*

7. *A. nitidus*, the Plumbeous Falcon.
8. *A. poliogaster*, the Gray-Bellied Falcon.
9. *A. leucorrhous*, the Spotted Falcon.
10. *A. magnirostris*, the Great-Billed Falcon.

II. *Poliornis.*

1. *P. Teesa*, the Teesa Hawk.
2. *P. Liventer*, the Pale Hawk.
3. *P. Indicus*, the Gray-Cheeked Hawk.
4. *P. pyrrhogenys*, the Dark-Cheeked Hawk.

III. *Geranospiza.*

1. *G. gracilis*, the Slender Hawk.

IV. *Micrastur.*

1. *M. brachypterus*, the Pied Sparrow-Hawk.
2. *M. xanthothorax*, the Yellow-Necked Hawk.
3. *M. concentricus*, the Concentrical Sparrow-Hawk.

V. *Accipiter.*

a. *Accipiter.*

1. *A. nisus*, the Sparrow-Hawk.
2. *A. erythronemia*, the Red-Thighed Sparrow-Hawk.
3. *A. tachiro*, the Speckled Sparrow-Hawk.
4. *A. rufiventris*, the Red-Bellied Hawk.
5. *A. fuscus*, the American Brown Hawk.
6. *A. pileatus*, the Hooded Falcon.
7. *A. Madagascariensis*, the Madagascar Hawk.

b. *Hieraspiza.*

8. *A. tinus*, the Tiny Falcon.
9. *A. minullus*, the Dwarf-Falcon.
10. *A. virgatus*, the Streaked Hawk.

c. *Urospiza.*

11. *A. cirrhocephalus*, the New Holland Sparrow-Hawk.
12. *A. approximans*, the Australian Goshawk.

VI. *Micronisus.*

a. *Tachyspiza.*

1. *M. Soloensis*, the Soolo Falcon.

b. *Scelospiza.*

2. *M. Francesii*, Franco's Sparrow-Hawk.

c. *Micronisus.*

3. *M. badius*, Brown's Hawk.
4. *M. sphenurus*, the Short-Toed Sparrow-Hawk.
5. *M. Gabar*, the Red-Legged Falcon.
6. *M. monogrammicus*, the Single-Streaked Hawk.

VII. *Melierax.*

1. *M. musicus*, the Chanting Falcon.

Sub-Family VII. *Circinæ.*

I. *Serpentarius.*

1. *S. secretarius*, the Secretary.

II. *Polyboroïdes.*

1. *P. radiatus*, the Madagascar Falcon.

III. *Circus.*

a. *Strigiceps.*

1. *C. cyaneus*, the Hen-Harrier.
2. *C. melanoleucus*, the Black and White Indian Falcon.
3. *C. acoli*, the Long-Legged Falcon.
4. *C. cinereus*, Quoy's Buzzard.
5. *C. ater*, the Black Hen-Harrier.

b. *Glaucopteryx.*

6. *C. cinerescens*, the Ash-Coloured Falcon.
7. *C. Swainsoni*, the Pale-Chested Harrier.

c. *Spilocercus.*

8. *C. Jardinii*, Jardine's Hen-Harrier.

d. *Spizacircus.*

9. *C. macropterus*, the Salvador Falcon.

e. *Pygargus.*

10. *C. æruginosus*, the Moor-Buzzard.
11. *C. assimilis*, the Allied Moor-Buzzard.
12. *C. ranivorus*, the Ranivorous Falcon.

We subjoin a list of the British species of *Falconidæ* from Mr. Yarrell's 'British Birds':—

Aquila nævia, the Spotted Eagle.
A. chrysaëtos, the Golden Eagle.
Haliæetus albicilla, the White-Tailed Eagle and Cinereous Eagle.
Pandion Haliæetus, the Osprey, or Fishing-Hawk.
Falco Gyrfalco, the Gyr-Falcon.
F. peregrinus, the Peregrine Falcon.
F. subbuteo, the Hobby.
F. rufipes, the Red-Footed Falcon.
F. Æsalon, the Merlin.
F. tinnunculus, the Kestrel or Windhover.
Astur palumbarius, the Goshawk.
Accipiter nisus, the Sparrow-Hawk.
Milvus vulgaris, the Kite, the Fork-Tailed Kite and Glead.
Nauclerus furcatus, the Swallow-Tailed Kite.
Buteo vulgaris, the Common Buzzard.
B. lagopus, the Rough-Legged Buzzard.
Pernis apivorus, the Honey-Buzzard.
Circus æruginosus, the Marsh-Harrier.
C. cyaneus, the Hen-Harrier.
C. Montagui, Montagu's Harrier.

A very fine collection of the *Falconidæ*, unequalled in the number of species, is at present to be seen in the Gardens of the Zoological Society, Regent's Park, London.

FALCONRY, or HAWKING, the art of training and flying hawks to take other birds. Julius Firmicus, who lived in the middle of the 4th century, is the first Latin writer who speaks of falconers, and the art of teaching one species of birds to fly at and catch another. The art however had been in all probability practised in the east from remote ages, whence it certainly came to Europe.

From the Heptarchy to the time of Charles II. falconry was the principal amusement of our ancestors in England. A person of rank scarcely stirred out without a hawk upon his hand, which, in old illuminations and upon ancient seals, is the criterion of nobility. Harold, afterwards king of England, is thus represented in the Bayeux Tapestry, when visiting the court of William, duke of Normandy.

Florence of Worcester (4to edit. 1592, p. 310) states that King Alfred had his falconers among the persons whom he encouraged for their skill in different professions; and a metrical treatise on the art of falconry, still extant, is ascribed to King Edward the Confessor.

In Domesday Book the practice of falconry is illustrated by numerous entries. In several places we find a sum, no less than ten pounds, made the optional payment instead of finding a hawk ('Domesday Book,' tom. i. fol. 134, b. 172, 230); and once, at Worcester (tom. i. 172) a Norway hawk is specified. Aeries, or places destined for the breeding or training of hawks, are entered in the Survey, in Buckinghamshire, Gloucestershire, Worcestershire, Herefordshire, Shropshire, and, more frequently than in other counties, in Cheshire; as well as among the lands between the Ribble and the Mersey. ('Domesday Book,' tom. i. fol. 144, 152, 163 b, 172, 180, 252 b, 256 b, 257, 264, 265, 265 b, 266 b, 267, 267 b, 268 b, 269, 270.)

Nor were hawks less prized at subsequent periods. According to Madox ('Hist. Excheq.' i. 273), in the 14th Hen. II., Walter Cnot, one of the king's tenants, rendered his rent at the exchequer in three hawks and three girfalcons. King John had also his hawks ('Pat.' 4, 'Joh.' m. 2); and upon the Patent Roll of the 34th Hen. III. a copy occurs of the letter which the king sent in that year to the king of Norway for hawks. Bray, in the 'History of Surrey' (vol. iii. p. 82), relates a curious anecdote of Henry III.'s anger with one Roger Belet, who, by reason of something he had done or omitted about a sparhawk, was disseised of all his lands and 40*s*. rent in Bagshot. In the 34th Edw. III. it was made felony to steal a hawk; to take its eggs, even in a person's own ground, was punishable with imprisonment for a year and a day, besides a fine at the king's pleasure. In Queen Elizabeth's reign the imprisonment was reduced to three months; but the offender was to find security for his good behaviour for seven years, or lie in prison till he did. (Pennant, 'Brit. Zool.' 8vo, Lond. 1812, vol. i. p. 212.)

Edward III., according to Froissart ('Chron.' i. c. 210), had with him in his army, when he invaded France, thirty falconers on horseback, who had charge of his hawks; and every day he either hunted or went to the river for the purpose of hawking, as his fancy inclined him. Queen Elizabeth is represented enjoying this sport in a woodcut in Turbervile's 'Falconry,' published in 1575; and it was the favourite amusement with King James I.

By an entry upon the 'Originalia Rolls' of the 35th Edw. III. ('Origin.' vol. ii. p. 267), it appears that a falcon gentil cost 20*s*.; a tersil gentil, 10*s*.; a tersil lestour, 6*s*. 8*d*.; and a lanner, 6*s*. 8*d*.: these were the prices which the sheriff was to give for hawks for the king's use. In an account-book of the 20th Hen. VIII. a goshawk and two falcons are prized at 3*l*., and five falcons and a tersil at 8*l*. Bert, in his 'Address to the Reader,' prefixed to his 'Treatise of Hawkes and Hawking,' published in 1619, says he "had for a goshawke and a tarsell a hundred marks."

Falconry was attempted to be revived by George, earl of Orford, who died in 1791; and in Yorkshire Colonel Thornton had a hawking establishment at a rather later period. Sir John Sebright and a few other gentlemen also practised it in Norfolk at the beginning of the present century. As a rural diversion however, principally in consequence of the inclosures, it has gone into disuse.

A list of the hawks which were most used by sportsmen in the time of Charles I. is given in Walton's 'Complete Angler;' and an explanation of the words of art in hawking will be found in Latham's 'Falconry,' 4to, Lond. 1633.

The earliest printed treatise on hawking in English is the 'Book of St. Albans,' fol. 1481, ascribed to Juliana Barnes or Berners, abbess of Sopwell. There are numerous other and curious treatises upon falconry both in French and English, some of them of very rare occurrence. 'Le Miroir de Phebus, avec l'Art de Fauconerie,' published at Paris in 8vo. without date, was the first work upon the subject printed in the French language.

For further information upon falconry and its practice the reader may refer to Spelman's 'Glossary,' v. 'Acceptor,' edit. fol., Lond. 1626, p. 7; Warton's 'Observ. on Spenser's Fairy Queen,' vol. ii. pp. 171-173; Strutt's 'Sports and Pastimes of the People of England,' 4to., Lond. 1810, pp. 21-33; and Haslewood's 'Literary Researches into the History of the Book of St. Albans,' 4to., Lond. 1810, pp. 21-48.

FALCOPERN. [FALCONIDÆ.]

FALCUNCULUS. [LANIADÆ.]

FALLOPIAN TUBES, so called from Fallopius the anatomist, who first accurately described them. They are tortuous and slender membraneous canals, about three inches in length, which proceed on each side from the two upper corners of the flattened triangular or pear-shaped body of the uterus. They communicate with its cavity by minute openings capable of admitting a large bristle. As they diverge outwards from their origin they enlarge, and, curving backwards, terminate obliquely in open fringed extremities directed towards the ovaries, which lie below and somewhat behind them. They are included, as are likewise the ovaries, in the duplicature of the peritoneal lining of the abdomen, called the broad ligaments of the uterus, by which that body is itself invested and attached laterally to the cavity of the pelvis. A production of this membrane sheathes them to their loose trumpet-shaped extremities, and turning over the edge is continued for some distance up the interior surface, finally blending with the mucous lining which accompanies them in their exit from the uterus. This is the only instance in the body of the continuity of a serous and mucous membrane, and probably has some concern in the spreading of inflammation from the interior of the uterus to the peritoneum, which constitutes one of the forms of puerperal fever.

Before the period of conception these tubes are observed in the lower animals to become more full of blood, and to have a writhing peristaltic motion like that which impels the aliment along the intestinal canal. Certain prominences are also observed at this time on the surface of the ovaries, produced by the maturation and swelling of the Graafian vesicles, which are the ova or germs of the future progeny. The Fallopian tubes then become attached by their open fimbriated mouths over these prominences; and receiving the vesicles as they burst through the peritoneal covering of the ovaries, convey them by the peristaltic motion we have mentioned into the uterus.

These germs are sometimes fecundated before they reach their destination, when what is called extra-uterine conception occurs. In these cases the germ never reaches the uterus at all, but remains in the intermediate canal, and becomes attached to its surface; in this position it may attain its full size, expanding the tube as it grows, till at length it gives way, and the fœtus escapes into the general cavity of the abdomen. Such cases are not necessarily fatal; the fœtus, dead of course, sometimes becomes inclosed after a certain period in a membranous cyst, gradually extended around it from the parietes of the abdomen; and may remain for many years without exciting much irritation. In other instances abscesses form and break in succession, discharging the bones and other unabsorbed parts of the fœtus, and the case eventually does well. But such results are rare; and nothing but the Cæsarean operation affords much prospect of saving life.

FALLOW-CHAT. [SAXICOLA.]

FALLOW-DEER. [CERVIDÆ.]

FAMILIES OF PLANTS. The word Family in Botany is mostly applied to a group of Plants of the same value as a Natural Order. In this sense it has been mostly employed throughout the pages of this work. At the same time, in the arrangements of some writers, a Family is made a group of less value than an Order; whilst in the writings of others the term is loosely applied to distinguish any group of plants of higher value than a single species. It is thus sometimes employed synonymously with Genus. The names of natural orders, being mostly those of a genus, which serves as a type for the rest of the group, are easily Englished by adding the word Family. Thus the Order *Gentianaceæ* is called in English the Gentian Family, and so on. By this means the word Family is sometimes restricted to the species of a genus. Another word used synonymously with Natural Order by Dr. Lindley is Tribe. In his Natural System, all the orders having typical genera with English names have been called Tribes, with the English names attached. Thus, *Cinchonaceæ*, the Coffee tribe; *Pistiaceæ*, the Duck-Weed tribe; *Euphorbiaceæ*, the Euphorbium tribe. At the same time, Tribe is frequently used to express a group of less value than an

Order, as in the larger orders, *Umbelliferæ*, *Leguminosæ*, *Compositæ*, *Cruciferæ*, &c. More recently, Dr. Lindley has endeavoured to give a single English word to express each natural tribe or order: thus, *Magnoliaceæ* are called Magnoliads; *Scrophulariaceæ*, Figworts; *Galiaceæ*, Stellates. We have added these names after each order in the 'English Cyclopædia.'

The following plan will give an idea of the relative value of terms used in the subdivisions of Plants :—

Class.
Sub-Class.
Group.
Alliance.
Order, or Family.
Sub-Order, or Sub-Family.
Tribe.
Sub-Tribe.
Division.
Sub-Division.
Genus.
Sub-Genus, or Section.
Species.
Variety.

The divisions, groups, and alliances between the sub-class and order are adopted by Lindley in his Natural System, and frequently occur in this work. It is only a few orders, such as *Compositæ*, that require the subordinate divisions above, and only the larger genera require to be divided into sub-genera.

FARINA. [STARCH.]

FASCICLE, in Botany, is, strictly speaking, that kind of inflorescence in which the flowers are arranged in a flat-headed raceme or corymb, and begin to expand in the centre sooner than at the circumference. The term is however constantly applied to any collection of flowers or leaves in clusters at the end or on the sides of a branch: thus, the leaves of the larch are called fasciculate.

FASCIOLA, a name given to various forms of Trematode Worms. [ENTOZOA.]

FASSAITE. [PYROXENE.]

FAT. This substance varies in properties according to the animals producing it. In all cases however it is composed of three different kinds, which differ as to their melting point: these are termed Olein, or Elain, Stearin, and Margarin. It is not however to be considered that the substances to which these names are given are in all cases absolutely identical; they vary as to smell, taste, solubility in alcohol, &c.; but all fats agree in being insoluble in water, and in not containing any azote, which is a common constituent of most other animal matter. Olein, Stearin, and Margarin are composed of acids called oleic, stearic, and margaric acids, combined with a base called Glycerine. Glycerine is the oxide of a compound radicle called Lipyle. [ADIPOSE TISSUE.]

Human Fat varies a little according to the part of the body producing it: that from the region of the kidneys, after it has been melted, is yellowish and inodorous; it begins to concrete at 76° Fahr., and is solid at 64°; it dissolves in forty times its weight of alcohol of 0·821 when boiling, and on cooling stearin is deposited, which, after pressure in bibulous paper at 78°, is colourless, fusible at 122°, and may be cooled to 106° before it begins to congeal; its temperature, on account of the evolution of latent heat, then rises to 120°: 21·5 parts of this stearin are soluble in 100 parts of boiling anhydrous alcohol, the greater part of which separates in acicular crystals on cooling.

The Olein of human fat is a colourless oily sweetish fluid, and remains so at 40°; at 60° its specific gravity is 0·913; 123 parts of this Olein are soluble in 100 parts of boiling alcohol; on cooling to 170° the solution becomes turbid.

Ox Fat.—When this has been fused it begins to solidify at 98°, and the temperature then rises, for a reason already mentioned, to 102°. Forty parts of boiling alcohol, of specific gravity 0·821, dissolve one part of it; and it contains about three-fourths of its weight of stearin, which is solid, hard, colourless, not greasy, and of a granular crystalline texture; it fuses at about 112°, and may then be cooled to 102°, when, on congealing, it rises to 112°. It burns like white wax. Of this stearin about 15·5 parts are dissolved by 100 parts of anhydrous alcohol.

The Olein of ox fat is colourless, nearly inodorous, and its specific gravity is 0·913: boiling alcohol dissolves nearly one-fourth more than its weight.

Sheep's Fat (or Mutton Suet) greatly resembles that of the ox; it is however whiter, and by exposure to the air acquires a peculiar odour. After fusion it congeals at a temperature varying between 98° and 102°; it dissolves in 44 parts of alcohol of specific gravity 0·821. The Stearin is white, translucent, and after fusion but imperfectly crystalline; about 16 parts are dissolved by 100 parts of boiling anhydrous alcohol. The Olein of mutton suet is colourless; its specific gravity is 0·913; and 80 parts of it are dissolved by 100 parts of anhydrous alcohol at 168°.

Hog's Fat, or Hog's Lard, is a soft colourless solid, which fuses between 78° and 86°; its specific gravity at 60° is 0·938. By powerful and long-continued pressure at 42°, between folds of blotting-paper, it is stated to yield ·62 its weight of colourless olein, of specific gravity 0·915; of this, 100 of boiling alcohol dissolve 123 parts. The Stearin of hog's lard is inodorous, solid, and granular, which, after fusion, remains liquid down to 100°, and then, on congealing, the temperature rises to 109°. It becomes acid by exposure to the air.

Goat's Fat contains a peculiar fat, termed Hircin by Chevreul, and to the presence of this its peculiar odour is owing, and which remains to a great degree with the olein when this is separated from the stearin: by particular management this fat yields hircic acid.

The Fat of Birds.—Goose Fat is colourless, and of a peculiar taste and smell; after fusion it congeals at 80° into a soft solid of the consistence of butter. When subjected in bibulous paper to pressure at 30°, 100 parts are separable into 68 of olein and 32 of stearin, fusible at 112°. The Fat of Ducks fuses at 76°, and yields 72 olein and 28 stearin, fusible at 120°. Turkey's Fat is separable into 74 olein and 26 stearin, fusible at 112°. [OILS; ADIPOSE TISSUE.]

FATHER-LASHER. [COTTUS.]

FAUJASITE, a Mineral, consisting of a hydrous silicate of alumina, with lime and soda. It occurs crystallised in the form of an octohedron with a square base. Its colour is white, sometimes brown. Fracture vitreous or uneven. Fragile. Lustre brilliant. It is so hard as to scratch glass. It is found with *Augite* at Kaisarstuhls in Breisgau. Analysis, by Damour :—

Silica	49·36	
Alumina	16·77	
Lime	5·00	
Soda	4·34	
Water	22·49	
		97·96

FAULT. [COAL-FORMATION; GEOLOGY.]

FAUNA, a term employed by naturalists to express the whole of the members of the animal kingdom living in a particular district or at a particular time. Thus all the animals living in Great Britain constitute the British Fauna. Those inhabiting the land form the Terrestrial Fauna; those found in the seas constitute the Marine Fauna. It is often applied collectively to all the animals of the world, the extinct species constituting the Fossil Fauna, and the living species the Recent Fauna of the world. The word is derived from the Fauni, who were supposed to be the patrons of wild animals.

The word Flora is also applied in the same way, to comprehend the whole of the plants of a district, and admits of the same applications as the term Fauna. It is derived from Flora, the goddess of flowers. [FLORA.]

FAUVETTE. [SYLVIADÆ.]

FAVASTRÆA. [MADREPHYLLIÆA.]

FAVOSI'TES, a genus of Fossil *Zoophyta*, common in the Silurian strata of Norway and Wales. (Murchison, 'Sil. System.')

FAVULA'RIA, a generic title of certain Fossil Plants allied to *Sigillaria*, as *F. tessellata*, from the Coal-Formation. (Sternberg.) [COAL-PLANTS.]

FEATHER-ALUM, a hydrous sulphate of alumina, not mixed with any other sulphate. It occurs more frequently than the true Alums, which are double salts.

FEATHER-GRASS. [STIPA.]

FEATHER-ORE, a Mineral, consisting of sulphuret of antimony and lead. It occurs in fine capillary crystallisations like a cobweb. Its colour is dark lead-gray. It is found in the Eastern Harz. Its composition is—

Antimony	31	
Lead	47	
Sulphur	20	
		98

FEATHERS. [BIRDS.]

FECULA, or FÆCULA. [STARCH.]

FECUNDATION. [REPRODUCTION.]

FEDIA. [VALERIANELLA.]

FEELING. [NERVOUS SYSTEM; TOUCH.]

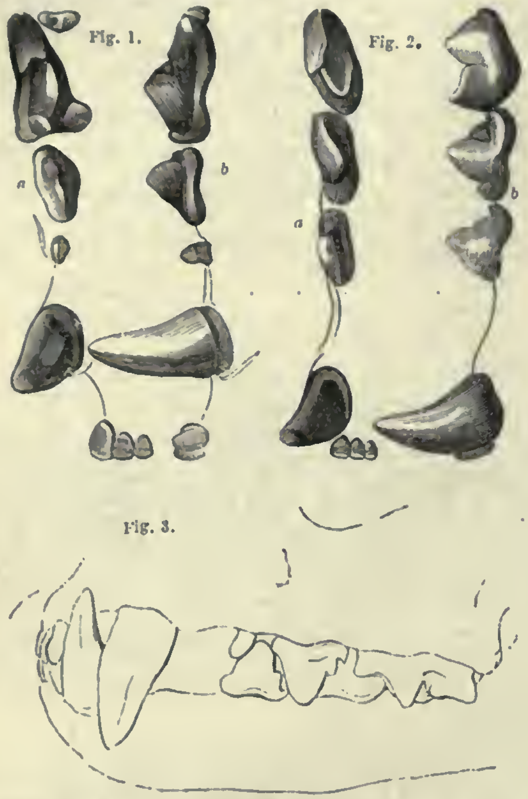
FE'LIDÆ, or FELINA, a Family of the Cat kind, of the order *Carnivora*, in which the organs of destruction reach their highest development. They are, among the quadrupeds, what the *Falconidæ* are among the Birds. Sometimes this family is made to include the Dogs, Hyænas, Wolves, and smaller *Carnivora*. We shall confine ourselves here to the members of the tribe *Felina* of Dr. J. E. Gray, comprising the Cats, Lions, Tigers, Leopards, and Lynxes.

The principal instruments of the destructive energy of these animals are the teeth and claws.

The dental formula then in these animals is the following :—

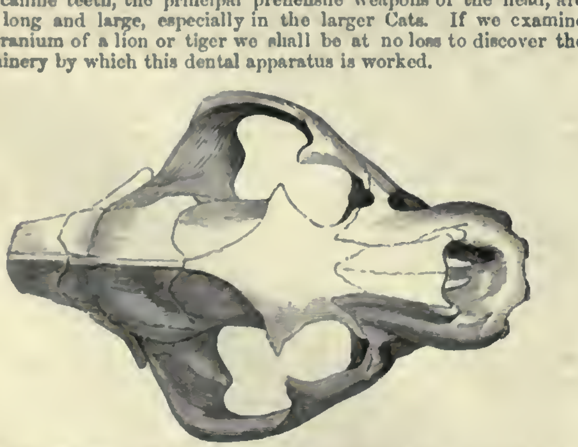
$$\text{Incisors, } \frac{6}{6}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{4-4}{3-3} = 30.$$

The formation of these teeth is beautifully shown in four preparations in the museum of the Royal College of Surgeons in London. No. 329 is the anterior part of the right ramus of the lower jaw of a young lion, exhibiting the teeth, together with the gums in which they are imbedded, and the border of soft parts, or lip, with which they are surrounded. No. 330 is the anterior part of the upper jaw of a young lion injected, in which the body of the second or permanent laniary (canine tooth, or cuspidatus) is pretty completely formed, and the fang forming. The laniary is cut down in the direction of its axis to expose the cavity containing the pulp on which it was forming. There is one of the molars in the act of being shed, and the adnlt or permanent tooth is pushing into the gum. No. 331 is the counterpart, or oposite section of the same laniary; and No. 332 is the laniary of the jaw of the opposite side af the same lion, showing the whole of the pulp on which it was forming. ('Catalogue, Physiological Series, Gallery,' vol. i.)



Teeth of the Cat Family. 1, upper jaw; *a*, internal view; *b*, external view: 2, lower jaw; *a*, internal view; *b*, external view: 3, teeth when the jaws are shut seen in profile. From F. Cuvier.

The articulation of the condyles of the lower jaw in which this formidable apparatus is set is so contrived as to cause its operation in the most efficient manner. These processes are situated in the same straight horizontal line; they are cylindrical, and firmly locked in the transversely elongated glenoid cavities, the margins of which are so extended both before and behind the condyle that rotatory motion is impossible. The crowns of the molar or rather lacerating teeth are compressed, and covered with enamel, as indeed are those of all the others: the molars terminate in pointed processes, and the lower teeth shut within the upper. Thus, when called into action, the teeth and jaws operate like the antagonist blades of a pair of scissors upon the substance submitted to their cutting edges. The canine teeth, the principal prehensile weapons of the head, are very long and large, especially in the larger Cats. If we examine the cranium of a lion or tiger we shall be at no loss to discover the machinery by which this dental apparatus is worked.



Skull of Lion seen from above, showing the extent of the zygomatic arches and temporal fossæ.

The Crista Occipitalis, which is most strongly marked in the cats, is a sharp and prominent bony ridge rising from the upper and hind portion of the skull. Its chief use is for the attachment of the temporal muscle, and the size of the temporal fossa, and the strength and extent of the zygomatic arch depend upon the magnitude of that muscle. In no animals is this fossa larger than in the *Carnivora*. It not only occupies the whole of the sides and upper part of the skull, but is still further increased by the prominent bony crests proceeding from the frontal, parietal, and occipital bones. The temporal muscles would indeed almost completely cover the cranium in many of these animals, were it not for their separation by the parietal ridge.

Skull of Lion seen in profile, showing the prominent bony crests.

The zygomatic suture is so oblique that the temporal bone forms the whole superior margin, and the os malæ the inferior edge of the zygoma.

In consequence of the construction which we have endeavoured to explain, the lower jaw is capable of motion only upwards and downwards, and entirely incapable of that motion in a horizontal direction, which is necessary to mastication, properly so called. Accordingly the Cats cut and lacerate their food coarsely, and transmit it in large portions to the stomach, there to be acted on by the gastric juice.

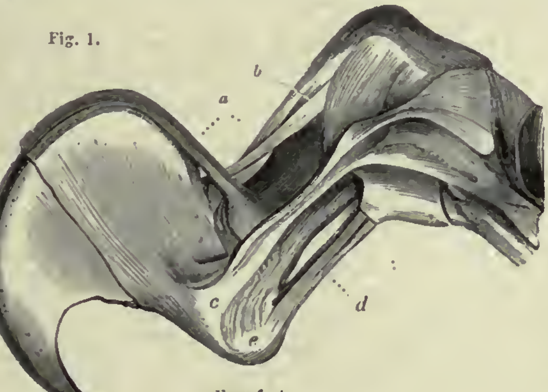
The muscles of the neck and fore quarter of the Cats are especially powerful to give full effect to this part of the organisation, and to enable the animal to drag or carry away its prey.

We must next turn our attention to the other organs of prehension, the claws.

The five toes of the anterior and four toes of the posterior extremities of the Cats are armed with very strong, hooked, sub-compressed sharp claws. These extremities, the anterior ones especially, thus become powerful instruments for seizing and rending the prey. The muscles that are to wield these weapons are of great strength; those of the fore arm especially, which in the lion and tiger offer the same arrangement for flexion, extension, pronation, and supination, as is observed in man, are highly developed, and the blow alone which the animal can deal with this limb is frequently fatal. It is asserted that the Bengal Tiger has been known to fracture the skull of a man with one stroke of its heavy paw. The claws, by a beautiful conformation, are always preserved without effort from coming in contact with external bodies, so as to keep them sharp and ready for action. There are some interesting specimens in the Museum of the Royal College of Surgeons in London, which will illustrate this provision. No. 287 of the 'Physiological Series' is a toe from the right fore foot of a lion, with the last phalanx retracted on the ulnar (which from the prone state of the foot is the outer) side of the second phalanx. This state of retraction is constantly maintained, except when overcome by an extending force, by means of elastic ligaments, two of which have bristles placed beneath them in the preparation. The principal one arises from the outer side and distal extremity of the second phalanx, and is inserted into the superior angle of the last phalanx; a second arises from the outer side and proximal end of the second phalanx, and passes obliquely to be inserted at the inner side of the base of the last phalanx; a third, which arises from the inner side and proximal extremity of the second phalanx, is inserted at the same point as the preceding. The tendon of the flexor profundus perforans, which is the antagonist of the ligaments, has been divided. No. 287 A is a toe from the left fore foot of a young lioness, with the last phalanx drawn out, as in the action of the flexor profundus. The same ligaments are shown as in the preceding preparation, together with the insertion of the flexor and extensor tendons. In order to produce the full effect of drawing out the claw, a corresponding action of the extensor muscle is necessary to support and fix the second phalanx; by its ultimate insertion in the terminal phalanx, it serves also to restrain and regulate the actions of the flexor muscle. A bristle is placed beneath that part of the extensor tendon which passes under one of the elastic ligaments to be inserted into the base of the last phalanx immediately above the articulation. In both preparations lateral processes of tendon may be observed going to the under part of the base of the phalanx, which are partly inserted there, and partly lost in the integument: they are given off from the extensor tendon as it passes over the proximate phalanx, and are joined by ligamentous fibres from the sides of the same phalanx.

No. 288 is a toe from the right hind foot of a lion, with the last phalanx drawn out, and the elastic ligaments put on the stretch. As the phalanges of the hind foot are retracted in a different direction to those of the fore foot, that is, directly upon and not by the side of the second phalanx, the elastic ligaments are differently disposed, as may be seen by comparing this with the preceding preparation. The outer ligament is of a flattened triangular form; it arises from the whole outer side of the middle phalanx, is strongest at the anterior margin, and is inserted at the superior angle of the last phalanx: the inner ligament is of a rounded form, arises from the inner side and distal end of the second phalanx, and is also inserted at the superior angle of the last phalanx, which is necessarily drawn back in the diagonal of the elastic forces. No. 288 A is the innermost toe or pollex of the right fore foot of a young lioness, exhibiting a disposition of the elastic ligaments and mode of retraction similar to the toes of the hind foot; but here the inner ligament is of the flattened triangular form, and the outer one rounded. The latter passes between a division in the extensor tendon, one part of which is inserted in the base of the last phalanx just above the articulation; the other part into the outer side of the base of the phalanx, and into the integument. ('Catalogue, Physiological Series, Gallery,' vol. i.) "It seems scarcely necessary," adds the able author of the foregoing description, "to allude to the final intention of these beautiful structures, which are, with some slight modifications, common to the genus *Felis*. The claws being thus retracted within folds of the integument, are preserved constantly sharp, and ready for their destined functions, not being blunted and worn away in the ordinary progressive motions of the animal; while at the same time, as soft parts only are brought in contact with the ground, this circumstance contributes to the noiseless tread of the feline tribe." ('Gallery.')

Fig. 1.



Fore foot.

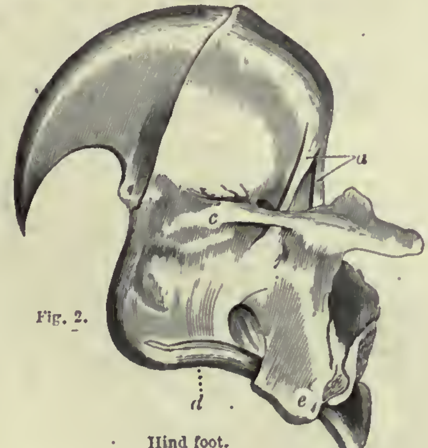


Fig. 2.

Hind foot.

Structure of the apparatus for retracting and extending the claws of the Cats, as exemplified in the fore foot and hind foot of the lion.

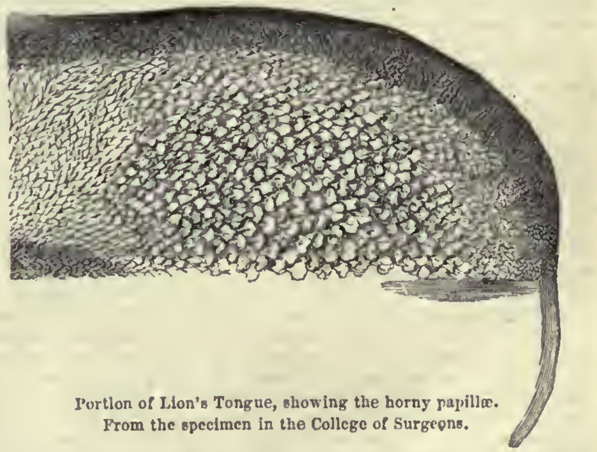
The elastic ligaments which retain the last phalanx and claw in a state of retraction are not the same in the fore and hind foot.

In *fig* 1, which is a toe from the left fore foot of a young lion, represented in a state of extensions, *a* points to the two elastic ligaments; *b*, the tendon of the extensor muscle; *c*, a process of inelastic tendon; *d*, the tendon of the flexor muscle, which passes over the upper extremity of the last phalanx at *e*, as over a pulley, and thus assists the powerful action of that muscle.

In *fig* 2, a toe from the hind foot, the two elastic ligaments (*a*) converge to be inserted into the upper angle of the last phalanx, and draw it backwards directly upon, instead of by the side, of the penultimate phalanx; *c* is a process of lateral inelastic tendon; and *d* the tendon of the flexor profundus, which is strongly strapped down by an annular ligament, *e*.

The claw is supported on the last phalanx, which is of a very peculiar form. Its two portions are united to each other at nearly right angles. The base of the claw is received into a groove in the body of the bone, to prevent its being pushed backwards in the violent action of the paws. The two parts of the bone form a species of hook or crotchet. The superior end of the phalanx in this state of repose is placed almost vertically; while the other extremity lies nearly parallel to the second. The articulation is at the upper end of the vertical portion, and the flexor tendons, passing over the upper part of the bone, are strongly fixed to the other portion. The action of the flexor profundus causes the whole bone to move through 90 degrees round the end of the second phalanx. (Dr. Traill.)

Having laid before the reader the mechanism of the parts more immediately concerned in the capture of the prey and the separation of its flesh, we must notice another organ which in the Cats is used for other purposes than those of mere taste and deglutition. The roughness of a domestic cat's tongue is familiar to every one, as well as the action of lions and tigers in licking the bones of their prey in order to detach any remnants of flesh that may be adhering thereto. This is effected by numerous horny papillæ, which are differently arranged in different species, some having them in straight rows, others in alternate lines; but in all the points are directed backwards. In the Museum of the Royal College of Surgeons are preparations well illustrating the structure of the tongue in these animals. No. 1509 exhibits the tongue and larynx of a young lion injected. The tongue is of considerable length, in consequence of the distance at which the larynx and os hyoides are placed behind the bony palate. The soft palate is of a proportional extent. All that part of the tongue which corresponds to the soft palate is smooth; as it advances forwards it is covered with large soft papillæ directed backwards; then there are four large fossulate papillæ, anterior to which the simple conical papillæ continue increasing in size to near the tip of the tongue: the strong cuticular spines with which they are armed have been removed, showing the vascular secreting surface beneath. With the larynx there are preserved the thyroid glands and part of the wide trachea. No. 1510 is a portion of the cuticular covering of the smaller posterior conical papillæ, from the preceding tongue. No. 1511 shows a portion of the cuticular covering of the anterior papillæ of the same tongue. At the fore part of the base of each of the larger spines may be observed a group of small gustatory papillæ. No. 1512 is the extremity of the tongue of a lion, with the cuticular covering of the papillæ removed from one side; and No. 1513 is the anterior part of the tongue of a lion, with the cuticular and spiny covering of the papillæ preserved. ('Catalogue, Physiological Series, Gallery,' vol. iii.)



Portion of Lion's Tongue, showing the horny papillæ. From the specimen in the College of Surgeons.

Professor Owen remarks, that in the Cats generally the connection of the os hyoides with the cranium is not by a long elastic ligament, as in the lion, but by an uninterrupted series of bones, and that this latter structure exists in the Cheetah (*Felis jubata*).

This leads us to the other digestive organs. In the *Felidæ* the salivary glands are small, as might be expected where it can hardly be said that mastication is exercised. The stomach of the lion is divided, by a slight contraction in its middle, into two portions. Its coats, particularly the muscular coat, are very strong, as in most of the *Carnivora*. Blumenbach observes, that in most carnivorous quadrupeds, particularly those of a rapacious nature, the stomach bears a considerable resemblance on the whole to that of the human subject. Mr. Lawrence, in his notes, remarks, that the food of carnivorous animals, approaching in its constituent elements more nearly to those of the animal than that of the herbivorous tribes, is more easily reduced into the state which is required for the nourishment of the body in the former than in the latter case. In the *Carnivora*, the stomach, which is of a cylindrical form, has no cul-de-sacs; the œsophagus opens at its anterior extremity, and the intestine commences from the posterior, so that everything favours a quick passage of the food, which receives no mastication, and is retained a very short time in the stomach. The intestine has no valves, is small in diameter, but muscular, and the whole canal, when compared with the body, is extremely short, being as 3 or 5 to 1. It is worth noticing, that in the Domestic Cat they are as 5 to 1, but in the Wild Cat they are only as 3 to 1. Some of the *Carnivora* have no cæcum, and in those that have this appendage it is constantly small and uniform in its cavity. In the Museum of the College of Surgeons are four preparations, Numbers 693 to 696 (Gallery), both inclusive, showing the structure of the intestines of a lion. No. 724 shows the termination of the ileum of a lion, with the cæcum or caput coli injected. The cæcum is simple, resembling that of the Suricate (*Ryzæna tetradactyla* of Illiger), with its apex similarly occupied by a cluster of glands; the terminal orifice of the ileum is also of a circular form, but it is situated on a valvular prominence in the large intestine. No. 730 is the injected colon of a lion. The longitudinal muscular fibres are very strong, and are disposed around the whole circumference of the intestine, which consequently is not drawn up into sacculi. The lining membrane is smooth, and is thrown into zig-zag rugæ. No. 736 is a portion of the rectum of a lioness, showing the strong round fasciculi of longitudinal fibres forming the outer stratum of the muscular coat, part of which has been turned down to show the inner circular fibres. The intestinal glands of the ileum in the lion are shown by No. 757. No. 806 shows the liver of the Domestic Cat, and its subdivision, as in all carnivorous quadrupeds, into a great number of lobes. The second lobe from the left side, or cystic lobe, is deeply cleft for the insertion of the suspensory ligament; to the right of this cleft it is perforated for the lodgement of the gall-bladder. No. 807 is the cystic lobe of the same species, showing that the gall-bladder is situated in the middle of the substance of the large lobe. ('Catalogue, Gallery, Phys. Series,' vol. i.) Blumenbach remarks that the ductus choledochus forms a pouch between the coats of the intestine for receiving the pancreatic duct in the Cat. No. 821 in the Museum of the College of Surgeons displays a portion of the duodenum, with the termination of the hepatic and pancreatic ducts of a lion. A black bristle is passed into the ductus communis choledochus, and a white one into the pancreatic duct; the mucous coat of the intestine is laid open to show their junction. The orifice of a distinct pancreatic duct is preserved. No. 837 is the spleen, with a portion of the duodenum and pancreas of a domestic cat. The spleen is of an elongated trihedral form, attached to the stomach by a duplicature of peritoneum inclosing its vessels; this duplicature passes off from the angle formed by the two lesser sides. The splenic vein is seen passing from the spleen along the pancreas, which extends from it to the duodenum. No. 840 exhibits the stomach and duodenum, spleen, pancreas, and great omentum of a small carnivorous animal, apparently of a cat. The parts have been injected, and show remarkably well the principal peculiarities in the form and disposition of these parts as they exist in the feline tribe. A part of the œsophagus has been inverted, to show the transverse rugæ of its lining membrane, near its termination. The stomach exhibits the broad dilated cardiac and the narrow tubular pyloric divisions, which are acutely bent upon each other; in the duodenum may be observed its regular extended curve, and its broad mesentery, by which much greater freedom of motion is allowed to this portion of the intestinal canal than in the human subject. The small omentum is seen attached, not in a regular line along the lesser arch of the stomach, but advancing in an irregular scolloped manner upon its anterior surface; an analogous process of peritoneum is attached posterior to the lesser curvature. The great omentum anteriorly is continued from the greater arch of the stomach, from the left end of which it is continued down the spleen, and posteriorly along the pancreas, which is thus seen to have an entire investment of peritoneum; from the pancreas it extends to the pylorus, where it becomes continuous with the anterior layer, completing the circle, and leaving a large aperture behind the lesser arch of the stomach, which leads into the omental cavity analogous to the foramen Winslowi. The form of the pancreas and its division into the transverse or greater lobe and the circular or duodenal lobe are well shown, and also the form and situation of the spleen. ('Catalogue, Gallery, Phys. Series,' vol. i.)

The terrific roar with which the larger animals of this family rush on their prey is well known, and well calculated to paralyse the nervous system of the victim with fear. Stealing on the victim with noiseless tread till couched within the proper distance for their spring, these destroyers leap on it with a horrid sound which salutes its ear in the same moment almost that it feels the blow of the deadly talons and the murderous gripe of the teeth. The cartilages of the larynx of a lion, the large size of the vocal organ, and the rounded contour of the epiglottis, may be seen in preparation No. 1172 (Gallery) of the Museum of the Royal College of Surgeons. From the narrowness of the thyroid cartilage anteriorly, there is a considerable interval at that part between the thyroid and cricoid cartilages, a structure which, as the 'Catalogue' tells us, obtains in all the feline animals. No. 1129 consists of the heart and lungs of a kitten, and shows principally the subdivision of the lungs into many lobes, and more especially the small azygos lobe of the right lung, filling up the space which intervenes between the heart and diaphragm in this and most other quadrupeds. Vicq-D'Azyr and Blumenbach notice the two delicate membranes lying under the ligamenta glottidis of the cat, which probably cause the purring noise peculiar to it.

"The structure of the kidney in *Mammalia*," observes Mr. Lawrence, in his notes to Blumenbach's 'Comparative Anatomy,' "displays two very opposite varieties, which may be called the simple and the conglomerated kidneys. In the former there is a single papilla, which is surrounded by an exterior crust of the cortical substance. This is the case in all the *Feræ*, and in some other animals, as many *Rodentia*." "In some animals," says John Hunter, "the kidney is a very oblong body, extending in length for a considerable way, and very narrow, as in some fish, while in other animals it is almost globular, as in the leopard. . . . In the lion kind, cat kind, as also in the hyæna, we find that perhaps one-half of the veins get on the external surface, and are either strongly attached to or pass in a doubling of the capsule of the kidney, and then pass along like the veins of the pia mater, afterwards joining the trunks from the inside just as they pass out. . . . The veins of the kidneys have in general nothing particular respecting them. They in common attend the arteries, or at least ramify similarly to the arteries, excepting in the lion and cat kind, as also in the hyæna, where some of the veins ramify on the surface, while the others are attending the arteries." The reader will find in the Museum of the College of Surgeons some beautiful preparations illustrative of the kidneys, &c., of the *Felidæ*: they are numbered 1200 to 1205 both inclusive, 1218 to 1221 both inclusive, and 1284. (Gallery.)

Blumenbach observes that in some species of the Cat kind the glans is covered with retroverted papillæ, which, as these animals have no vesiculæ seminales, may enable the male to hold the female longer in his embraces. Most of the Cats are retromingent, but not, as has been so often and erroneously repeated from the time of Aristotle, retrocopulant.

Brain, Nervous System, and Senses.—Blumenbach observes that the bony tentorium cerebelli constitutes in most species of the Cat kind a uniform bony partition which leaves a quadrangular opening in the lower part of the cranium. In the cat the brain forms $\frac{1}{156}$ of the body; the proportion of the weight of the cerebellum to the cerebrum is as 1 to 6, and the breadth of the medulla oblongata after the pons Varolii is to that of the brain as 8 to 22. In the Museum of the Royal College of Surgeons, No. 1324 (Gallery), is the brain of a tiger. The pia mater has been removed from the medulla oblongata, showing the transverse tract of medullary matter posterior to the tuber annulare, called corpus trapezoideum; this is traversed by the corpora pyramidalia. The development of the cerebrum is such as not only to cover the optic lobes or bigeminal bodies, but also the anterior half of the cerebellum itself; and the surface of the cerebrum is augmented by convolutions, of which one is analogous to the single convolution in the agouti, and extends parallel with the fissure dividing the hemispheres; a second runs parallel with and external to the preceding; a transverse one proceeding from the mesial fissure marks off what may be regarded as the anterior lobes, which, together with the lateral regions of the hemispheres, are traversed by other anfractuosities. No. 1325 is the brain of a lion, closely resembling the preceding in general form and disposition of the convolutions. No. 1326 is the brain and part of the spinal chord of a young lion, with the vessels of the pia mater minutely injected. The left lateral ventricle is exposed, showing the pes hippocampi and the choroid plexus. The fourth ventricle is also laid open, and contains a similar plexus of minute arteries. Bristles are inserted into the hollow olfactory and the optic nerves, and black threads are tied round the origins of the remaining cerebral nerves of the right side. A small quill is placed in the infundibulum; but the pituitary gland, which may be seen in both the preceding specimens, is here removed. The union of the vertebral arteries to form the basilar artery, the great length of that vessel, and its division to join with the internal carotids in the formation of the circle of Willis, are well displayed. No. 1326 is a portion of the basis of the brain of a lion, prepared to show the form and relative proportions of the bigeminal bodies or optic tubercles; of these, the posterior, though smaller in longitudinal diameter, are broader, and rise above the level of the anterior pair. No. 1372 and No. 1373 are two highly interesting preparations of the spinal chord and cauda equina of the lion. ('Catalogue,' vol. iii.)

Blumenbach enumerates the Cat kind among the animals remarkable for their acuteness in the sense of smelling, and as affording examples of a very complicated formation of the ethmoid bone, both in regard to the elegant structure of its cribriform lamella, and to the wonderful convolutions of its turbinated portions, which procure as large a surface as possible within the confined space of the nasal cavity, for the application of the Schneiderian membrane. The conchæ narium inferiores are also much convoluted. There is in the Museum of the College of Surgeons (Gallery) a preparation (No. 1552) of a longitudinal vertical section of the head of a leopard, showing the turbinated bones of the left side in situ; and another, No. 1553, of a longitudinal section of the side of the head of a young lion, showing the ossa turbinata in situ also. The following luminous description of the latter is given in the Catalogue ('Physiological Series,' vol. iii.) :—"The superior bone is of a conical form, extending along the whole of the roof of the nasal cavity, with its base opposite to the frontal sinus (which is here exposed), and its apex terminating above the anterior extremity of the inferior turbinated bone. It presents a smooth or uniform surface towards the nasal cavity, as may be seen in the preceding specimen; but the lamella forming this surface has been partially removed, showing the subjacent lamella, which is folded longitudinally: the more complicated disposition of the exterior lamella of the same bone is exhibited on the opposite side of the preparation, where the surface for the extension of the olfactory membrane is augmented by a series of deep arched folds, having their convexity upwards. The middle turbinated bone is also of a pyramidal form, its broad basis being applied to the cribriform plate of the ethmoid bone, and its apex extending between those of the other two turbinated bones, but not reaching so far forwards. The nasal or mesial surface of this bone is complicated by numerous deep furrows, two of which extend longitudinally, parallel with the superior margin of the bone, while the others radiate in an irregular manner from the lower point of attachment. The lateral surface of the bone is less complicated and extensive. The inferior and anterior turbinated bone is of an elongated form, and contracted at both extremities. Its posterior and inferior extremity is attached to the outer parietes of the nasal passage, below the middle of the turbinated bone: from this point it extends obliquely upwards, enlarging as it crosses the anterior extremity of the middle bone, and then diminishing in size to its anterior and superior attachment behind the external nostril: from its position therefore the odorous particles in inspiration must first impinge upon this bone. Its nasal surface is pretty uniform, presenting only one curved groove, parallel with and near to the lower margin of the bone, in this respect differing widely from the lower turbinated bone in the hare: its exterior surface is similarly characterised. In the preparation the outer lamella has been cut away to show the subjacent fold. The whole being minutely injected, the vascularity of the pituitary membrane extended over this vast and complicated surface is well displayed. The pituitary membrane is evidently thickest and most vascular at the anterior part of the cavity, where it must receive the first impression of the external air. A portion of the pituitary membrane is reflected from the base of the middle turbinated bone, showing the fibres of the olfactory nerves spreading over it. In No. 1554 (the opposite section of the same head) and No. 1555 (the intermediate section) this part of the organisation is still further illustrated.

The sense of hearing is acute in most of the Cats. There is, in the greater number of mammiferous quadrupeds, connected with the tympanum, another cavity which Blumenbach compares, with regard to the situation of the bony organ that contains it, to the mastoid cells in the temporal bone of man. In several animals (and the cat is one of them) this organ is a mere bony cavity. The ossicula auditûs, considering the lenticulus as only a process of the incus, are three, as in the human subject. In the Museum of the College of Surgeons there is a preparation (No. 1600, Gallery) of a section of the cranium of a young lion, including the organ of hearing of the left side. A part of the meatus is preserved with the membrana tympani, and the cavity of the tympanum is laid open, showing the convexity of the membrane turned towards it, as in most *Mammalia*. ('Catalogue,' vol. iii.)

Sight is acute in the *Felidæ*, and they have the nictitating membrane very large and moveable. The pigment, as far as is known, is generally speaking of two colours, and the anterior perforation of the iris is formed of two segments of large circles joined, giving it a long and a short axis, the long axis being vertical. In the Museum of the College of Surgeons (No. 1710, Gallery) is the eye of a lion minutely injected by the ciliary arteries, and the sclerotic coat transversely divided, and reflected from the choroid, to show the vascularity of that tunic. No. 1730 is a preparation of the eye of a lion, showing the broad patch of tapetum lucidum below and also a little above the insertion of the optic nerve. The succeeding numbers to No. 1733 inclusive are also illustrative of this part of the organisation in the lion and the leopard. John Hunter, 'Observations on Certain Parts of the Animal Œconomy,' remarks, that when the pigmentum is of more than one colour in the same eye, the lighter portion is always placed at the bottom of the eye, in the shape of a half-moon with the circular arch upwards; the straight line or diameter passing almost horizontally across the lower edge of the optic nerve, so that the end of the nerve is within this lighter coloured part, which makes a kind of semicircular sweep above it: and he observes that the shape is peculiar to the Cat, Lion, Dog, and most of the carnivorous tribe. Professor Owen observes that the Cheetah has the circular pupil of the Lion, Tiger, Leopard, and Jaguar. ('Zool. Proc.,' 1833.)

The osteology of the *Felidæ* presents little for the distinction of species except size, and in no animal does specific character depend upon size and colour more entirely than it does in this family. There are indeed differences: such for instance as that pointed out by Professor Owen between the skull of the lion and that of the tiger; but taken as a whole the skeleton of a cat is very nearly the miniature representation of that of a lion or a tiger. We accordingly find that the disposition of many leading zoologists has been to bring all the numerous species under one genus. Linnæus arranges them under *Felis*, the third genus of his order *Feræ*, placing them between the Dogs (*Canis*) and *Viverra*. Illiger assigns to them a position in his order *Falculata*, with the title *Sanguinaria*. Cuvier places them under the name of Les Chats (*Felis*, Linn.) among his Carnivores, the third family of his Carnassiers, between the Hyænas and the Seals. Temminck regards the genus *Felis* as an indivisible group zoologically, but separates them into two sections, the first comprising those which are found in the Old Continent and its archipelagos, 18 species in number; the second those which occur in the New World, of which he enumerates 9 species. Prince C. L. Bonaparte admits into his family *Felina* the genera *Proteles*, *Hyæna*, and *Prionodon*, a very questionable admission. Dr. Leach gives the Lions a generic distinction with the name of *Leo*. The Lynxes are separated as a genus by Dr. J. E. Gray, under the title of *Lynchus;* and the Hunting Leopard (*Felis jubata*,) is characterised generally by Wagler as *Cynailurus*. The whole family may be popularly divided into Lions, Tigers, Leopards, Lynxes, and Wild Cats, or Cats properly so called—the two latter terms being more particularly applicable to the smaller forms. Under the articles HYÆNINA, CANIS, VULPIDÆ, VIVERRIDÆ, BEARS, MUSTELIDÆ, PHOCIDÆ, will be found other families of *Carnivora*, some of which have been occasionally referred to the *Felidæ*.

Before proceeding to any description or illustration of this family, it will be advantageous to the student to be put in possession of M. Tomminck's well-considered and digested monograph of the genus *Felis*, divided into two sections, according to their geographical distribution.

Section 1.

This comprises the *Felidæ* of the Old Continent and its archipelagos.

Species.

Felis Leo, including the three varieties of Barbary, Senegal, and Persia.

F. Tigris, the Royal Tiger.

F. jubata, the Hunting Leopard.

F. Pardus, the Panther. Of this M. Temminck gives the following character:—When adult, less than the Leopard. Tail as long as the body and the head, its extremity when turned back reaching to the tip of the nose; colour of the fur deep-yellowish fulvous, its internal part marked with rose-like spots of the same hue as the ground-colour of the fur; the numerous spots closely approximated; the rose-like spots from 12 to 14 lines at the utmost in diameter; caudal vertebræ 28.—N.B. The number of caudal vertebræ assigned to the Leopard by M. Temminck is 22. It would appear that there is no correct figure of the true Panther.

The Black Tiger, *Felis melas*, Rimau Kumbang of Sir Stamford Raffles, is considered as only a dark variety of the Leopard.

F. Uncia is considered as also to be erased from the list of species, as it is only the young of the Leopard or Panther.

F. macrocelis, the Rimau-Dahan.

F. Serval, comprising *F. Serval* and *F. Capensis*, Linn., the Chat-Pard of Desmarest, and the Caracal of Bruce.

F. cervaria, the Lynx.

F. Catus.

F. maniculata.

F. minuta, identical with the *F. Javanensis* of Horsfield's 'Zoological Researches in Java,' and therefore not to be adopted.

Section 2.

This comprises the *Felidæ* of the New Western World.

F. concolor, the Puma.

F. Onca, the Jaguar.

F. Jaguarondi.

F. celidogaster. Bought by M. Temminck at the sale of Mr. Bullock's collection for the Museum of the Netherlands.

F. rufa, Guldenst., Bay-Cat of Pennant. With this M. Temminck describes also a specimen brought from Mexico, which may prove distinct. Bought by M. Temminck at Mr. Bullock's sale for the Museum of the Netherlands.

F. pardalis, the Ocelot.

F. macroura.—N.B. These two last confounded together by Linnæus under the name of *F. pardalis*. The Mexican Tiger of Pennant is said to be representative of *F. macroura*.

F. mitis, the Chati, F. Cuv.

F. tigrina.

This monograph, as far as it goes, has been of great benefit; but the student should examine the menageries and museums, as well as the works of other authors, and he will find several Cats noticed both before and since the publication of M. Temminck's Catalogue. Among other authorities the publications of D'Azara, of Sir Stamford Raffles, of F. Cuvier, of M. Desmarest, of Dr. J. E. Gray, of Dr. Horsfield, and Mr. Vigors in the 'Zoological Journal,' of Dr. Horsfield in the 'Zoological Researches in Java,' of Prince Maximilian, of M. Lesson, of Sir William Jardine ('Naturalists' Library,' 'Mammalia,' vol. ii., *Felinæ*), and of Mr. Darwin ('Zoology of the Beagle') may be consulted with advantage.

Dr. Horsfield and Mr. Vigors ('Zool. Jour.,' vol. iv. p. 380) remark that they are not of M. Temminck's opinion, that the determination of species in such groups as these rests upon any examination, however acute, of preserved specimens in cabinets, or in any research, however extensive, into the stores of furriers. Such examination, they think, leads to conjecture; probable and plausible conjecture, it may be true, but still conjecture, and not facts. They add that we are in this way as likely to fall into the error of confounding true species as into that of creating nominal ones, and they express their opinion that the truth can be satisfactorily attained only by diligent researches in the native country of these animals, or by accurate observations on their changes and differences as to sex, age, and season, when in a living state and in confinement.

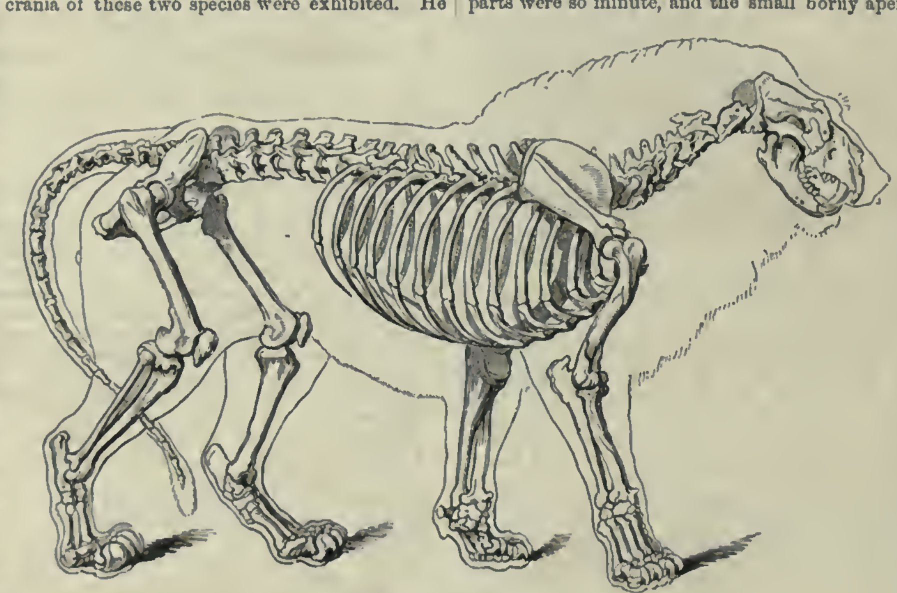
M. Temminck, in his 'Tableau Méthodique' (1827), states that then there were known 30 distinct species of Cats, and 7 or 8 other doubtful indications.

I. The Lions.

Lion is the English name for the form in which carnivorous development is generally considered to be the most perfect: Λέων of the Greeks (Λέαινα, Lioness); *Leo* of the Romans (*Lea* and *Leæna*, Lioness) Leone of the Italians (Leonessa, Lioness); Leon of the Spanish; Lion of the French (Lionne, Lioness; Linceau, whelp); Löwe of the Germans (Löwinn, Lioness). The male is, as a general rule, ornamented with a mane; the female has no such ornament.

There are, it appears, distinguishing characteristics marking the differences between the skulls of the Lion and Tiger. Professor Owen explained these to a meeting of the Zoological Society of London (1834), when several crania of these two species were exhibited. He adverted to the distinctions pointed out by Cuvier in the 'Ossemens Fossiles,' and remarked on the first of them; namely, the straightness of the outline in the lion from the midspace of the post-orbital processes to the end of the nasal bones in one direction, and to the occiput in the other, as not being in all cases available; but he regarded the second distinction—the flattening of the interorbital space in the Lion and its convexity in the Tiger,—as being more constant and appreciable. He pointed out however a distinction which had never, according to his belief, been published, which is, he observed, well marked, and which appears to be constant; for he found it to prevail throughout the whole of the skulls of these animals which he had examined, including ten of the Lion and upwards of twenty of the Tiger. It consists in the prolongation backwards in the cranium of the Lion, of the nasal processes of the maxillary bones to the same transverse line which is attained by the coronal or superior ends of the nasal bones; in the Tiger the nasal processes of the maxillary bones never extend nearer to the transverse plane attained by the nasal bones than one-third of an inch, and sometimes fall short of it by two-thirds, terminating also broadly in a straight or angular outline, just as though the rounded and somewhat pointed ends which these processes have in the Lion had been cut off. Professor Owen noticed also minor differences in the form of the nasal aperture, which in the Tiger is disposed to narrow downwards and become somewhat triangular, while in the Lion its tendency is towards a square shape; in the deeper sinking in a longitudinal depression of the coronal extremities of the nasal bones in the Tiger than in the Lion; in the bounding of this depression above in most of the Tiger's crania by a small but distinct semilunar ridge, which is not found in those of the Lion; and in the larger comparative size, chiefly in their transverse diameter of the infraorbital foramina in the Lion. Professor Owen remarked that it was curious that these foramina were double either on one or both sides in the only four skulls examined of lions which were known to be Asiatic, whilst in all the others the foramen was single on each side.

Another communication to the same society becomes interesting from its being associated with the popular belief that the Lion lashes his sides with his tail to stimulate himself into rage. There was exhibited at one of the meetings a claw obtained from the tip of the tail of a young Barbary Lion presented to the Society's menagerie by Sir Thomas Reade, then his majesty's consul at Tripoli. It was detected on the living animal by Mr. Bennett, and pointed out to the keeper, in whose hands it came off whilst he was examining it. The specimen having been submitted to Mr. Woods for description, that gentleman commenced by referring to the ancient writers quoted by Blumenbach. Homer ('Il.,' xx.), Lucan ('Pharsal.,' i. 208), Pliny ('Hist.,' viii.), among others, who had described the Lion (erroneously) as lashing himself with his tail when angry, or to provoke himself to rage. None of these writers however, he remarked, advert to any peculiarity in the Lion's tail to which so extraordinary a function might, however incorrectly, be attributed; but Didymus Alexandrinus, a commentator on the 'Iliad,' cited by Blumenbach, having found a black prickle-like horn among the hair of the tail, immediately conjectured that he had ascertained the true cause of the stimulus when the animal flourishes his tail in defiance of his enemies, remarking that when punctured by this prickle the Lion becomes more irritable from the pain which it occasions. Mr. Woods then noticed the oblivion into which the subject fell for centuries, till Blumenbach, who observes also that the later commentators, Heyne for instance, had noticed the opinion above stated, revived it, Blumenbach having verified the accuracy of Didymus Alexandrinus as to the fact, though he did not admit the commentator's inference. Blumenbach described the prickle as small, dark-coloured, hard as horn, placed in the very tip of the Lion's tail, surrounded at its base by an annular fold of the skin, and adhering firmly to a singular follicle of a glandular appearance. But Blumenbach remarked that these parts were so minute, and the small horny apex so buried in the tuft of hair, that the use attributed to it by the ancient scholiast can only be regarded as imaginary. Again, according to Mr. Woods, the subject appears to have slumbered till 1829, when M. Deshayes announced ('Ann. des Sci. Nat.,' vol. vii.) that he had found the prickle both of a lion and lioness which died in the French menagerie, and described it as a little nail or horny production, about two lines in length, presenting the form of a small cone, a little recurved upon itself, and adhering by its base only to the skin and not to the last caudal vertebra, from which it was separated by a space of two or three lines. From that period Mr. Woods suffered no opportunity to escape him of examining the tails of every lion, living or dead, to which he could gain access; but in no instance had he succeeded in finding the prickle till the specimen which was then before the committee was placed in his hands, within half an hour after its removal from the living animal, and while yet soft at its base where it had been attached to the skin. He described it as formed of corneous matter like an ordinary nail, and solid throughout the greater part of its length towards the apex, where it is sharp; and at the other extremity as hollow, and a little expanded. Its shape was rather singular, being nearly straight for one-third of its length, then slightly constricted (forming a very obtuse angle at the point of constriction), and afterwards swelling out like the bulb of a bristle to its termination. It was laterally flattened throughout its entire length, which did not amount to quite three-eighths of an inch. It was of a horn-colour, but became darker, nearly to blackness, at the tip. Its appearance, Mr. Woods observed, would lead to the belief that it was deeply inserted into the skin, with which however from the readiness with which it became detached, its connection must have been very slight. It is to this slightness of adhesion that M. Deshayes attributes its usual absence in stuffed specimens; and the same cause will account for its absence in by far the greater number of living individuals; for, as Mr. Woods remarked, its presence or absence does not depend upon age, because the Paris lions in which it was found were of considerable size, while that belonging to the Society was very small and young; nor upon sex, for although wanting in the

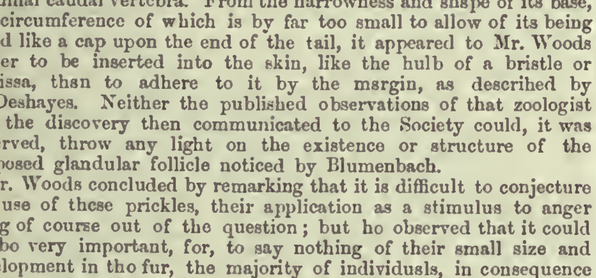


Skeleton of Lion.

female cub of the same litter at the Society's Gardens, it existed iu the lioness at the Jardin du Roi.

Mr. Woods, thinking it probable that these prickles might exist in other species of *Felis*, had previously examined the tails of nearly the whole of the stuffed skins in the Society's Museum, hut failed in detecting it in every instance but one. This was an adult Asiatic Leopard, in which the nail was evident, although extremely small. It was short and straight, but perfectly conical, with a broad base. Mr. Woods observed that it was stated in a note in the 'Edinburgh Philosophical Journal,' where a translation of Blumenbach's paper had been given, that a claw or prickle had also been observed by the editor of that work on the tail of a leopard. No such structure however was detected by Mr. Woods on a living individual in the Society's Menagerie. In the Leopard therefore, as in the Lion, it appears to he only occasionally present. In both it is seated at the extreme tip of the tail, and is altogether unconnected with the terminal caudal vertebra. From the narrowness and shape of its base, the circumference of which is by far too small to allow of its being fitted like a cap upon the end of the tail, it appeared to Mr. Woods rather to be inserted into the skin, like the hulb of a bristle or vibrissa, than to adhere to it by the margin, as described by M. Deshayes. Neither the published observations of that zoologist nor the discovery then communicated to the Society could, it was observed, throw any light on the existence or structure of the supposed glandular follicle noticed by Blumenbach.

Mr. Woods concluded by remarking that it is difficult to conjecture the use of these prickles, their application as a stimulus to anger being of course out of the question; but ho observed that it could not be very important, for, to say nothing of their small size and envelopment in tho fur, the majority of individuals, in consequence of tho readiness with which the part is detached, are deprived of it for the remainder of their lives. ('Zool. Proc.,' 1832.)



Prickle at the end of Lion's Tail. (Blumenbach.)

Emasculation, it is stated, prevents the development of the mane; and tho lion so mutilated is said never to roar.

The True Lions belong to the Old World exclusively, and they were formerly widely and plentifully diffused; but at present they aro confiued to Asia and Africa, and they are becoming every day more aud more scarce in those quarters of the globe. That lions were once found in Europe there can be no doubt. Thus it is recorded by Herodotus that the baggage camels of the army of Xerxes were attacked by lions in the country of the Pæonians and Crestonæi, on their march from Acanthus (near the peniusula of Mount Athos) to Therme, afterwards Thessalonica (now Saloniki): the camels alone, it is stated, were attacked, other beasts remaining untouched as well as men. Tho same historian also observes that the limits in Europe within which lions were then found were the Nessus or Nestus, a Thracian river running through Abdera and the Achelous, which waters Acarnania. (Herod., vii. c. 125-126, Schweighæuser.) Aristotle (vi. 31) says that the lion is in fact an animal hut little known. "In tho whole of Europe, for example, thero are no lions except between the Achelous and the Nessus." Again, the same author (viii., xxviii. 33 of Scaliger's division) mentions Europe as abundant in lions, and especially in that part which is between the Achelous and Nessus; apparently copying the statement of Herodotus. Pliny (viii. 16) does the same, and adds that the lions of Europe are stronger than those of Africa and Syria. Pausanias copies the same story as to tho attack of tho lions on the camels of Xerxes; and ho states moreover that lions often descended into the plains at the foot of Olympus, which separates Macedonia from Thessaly; and that Polydamas, a celebrated athlete, a contemporary of Darius Nothus, slew one of them, although he was unarmed. The passage in Oppian ('Cyneg.,' iii. 22) which some have considered as indicating the existence of lions up to the banks of the Danube, fails as an authority for placing the Lion in that locality, because, as Cuvier observes, the context shows plainly that the name of Ister is there applied to an Armenian river either by an error of the author or of the transcribers.

Nor is Europe the only part of the world from which the form of the Lion has disappeared. Lions are no longer to be found in Egypt, Palestine, or Syria, where they once were evidently far from uncommon. The frequent allusions to the Lion in the Holy Scriptures and the various Hebrew terms there used to distinguish the different ages and sex of the animal (see particularly Jer., li. 38; Ezek., xix. 2; Nah., ii. 13; Ezek., xix. 2, 3; Psalm xci. 13; Prov., xix. 12, &c.; Nah., ii. 12, &c.; Job, iv. 10—x. 16; Prov., xxvi. 13; Hosea, v. 14—xiii. 7; Prov. xxx. 30) prove a familiarity with the habits of the race. Even in Asia generally, with the exception of some countries between India aud Persia, and some districts of Arabia, these magnificent beasts have, as Cuvier observes, become comparatively rare, and this is not to ho wondered at. To say nothing of the immense draughts on the raco for the Roman arena—and they were not inconsiderahle, for, as Zimmerman has shown, there were a thousand lions killed at Rome in the space of forty years—population and civilisation have gradually driven them within narrower limits, and their destruction has been rapidly worked in modern times when fire-arms have been used against them instead of the bow and the spear. The African Lion is annually retiring before the persecution of man farther and farther from the Cape. Mr. Bennett ('Tower Menagerie') says of the Lion: "His true country is Africa, in the vast and untrodden wilds of which, from the immense deserts of the north to the trackless forests of the south, he reigns supreme and uncontrolled. In the sandy deserts of Arabia, in some of the wild districts of Persia, and in the vast jungles of Hindustan, he still maintains a precarious footing; but from the classic soil of Greece, as well as from the whole of Asia Miuor, both of which were once exposed to his ravages, he has been utterly dislodged and extirpated."

Lions of the Old World.—Zoologists generally distinguish tho Lion by its uniform yellow colour, the tuft of hair at the end of the tail, and the mane covering the head and shoulders of the male. This last ornament, as we shall presently see, is very much reduced in one variety with which we were made well acquainted some years ago by Captain Smee; indeed so scanty is it that it hardly deserves the name of a mane at all.

If we go back to an early period, we shall find varieties of this great cat, usually considered as the strongest of the family, depending on the greater or less inteusity of colour for the most part, meutioned by ancient writers on natural history. Thus, Aristotle (ix. 44) distinguishes two kinds of lions, one rounder than the other (*στρογγυλώτερον*), and which has the mane more curled (*οὐλοτριχώτερον*), which he states to be the most timid (*δειλότερον*); the other longer and with a well-developed mane (*εὔτριχον*), which he says is more courageous (*ἀνδρειότερον*). Pliny (viii. 16) remarks that the Lion is most noble when a mano covers his neck and shoulders; and he also (loc. cit.) alludes to a maneless lion, the offspring of a monstrous counection. ("Leoni præcipua generositas, tunc cum colla armosque vestiunt jubæ. Id enim ætate contingit e leone conceptis. Quos vero pardi generavere, insigni hoc carent.") In Africa, he goes on to remark, such connections are frequent: "Multiformes ibi animalium partus, vario fœminis cujusque generis mares aut vi aut voluptate miscente;" whence, he adds, the Greek vulgar saying, that Africa is always producing something new. In the same chapter, Pliny, after alluding to the European lions and their comparative boldness, as above stated, repeats the observation of Aristotle, that there are two kinds of lions, one compact and short with curled mane, which are more timid than those with a long and simple one ("longo simplicique villo"); which last despise the wounds inflicted on them. In the 17th chapter of tho same book, Syria is stated to be the locality of a hlack lion: "cæteris uuus cujusquo generis color est. Leonum tantum in Syria niger." Ælian (xvii. 26) distinguishes the lions which como from India from other lions, stating that the skin of the Indian lions is hlack. Oppian (iii.), towards the beginning of that book, notices the differences between the lions of Armenia, Arabia ('Ερεμβῶν ἄρουρα), Lihya, and Ethiopia.

These distinctions are altogether rejected by Buffon, who denies that there are different kinds of lions. He denies, also, that any lion has a curled mane, which, by the way, Aristotlo does not assert, for he only says that one kind has the mane more curly than the other. Buffon further affirms that the lions of Africa and Asia entirely resemble each other; and declares that if the lions of the mountains differ from those of the plains, the difference is less in the colour of the skin than in the size of the respectivo animals.

Linnæus, in his last edition of the 'Syst. Nat.,' notices no varieties: he places *Felis Leo* at the head of his genus *Felis,* with Africa only as tho habitat. Neither does Gmelin distinguish any varieties, but he much increases the distrihutiou; for he speaks of tho Lion as inhabiting Africa, especially in the interior, as being rarer in the deserts of Persia, India, and Japan, and as having formerly occurred in other warmer parts of Asia, in Palestine, in Armenia, and in Thrace.

Pennaut ('Hist. Quad.,' 3rd edition) appears to coincide in opinion with Buffon, Linnæus, aud Gmelin; for he mentions no distinctions, and describes the Lion as "au inhabitant of most parts of Africa, and rarely of the hot parts of Asia, such as India and Persia; and a few are still met with in the deserts between Bagdat aud Bassorah, on tho hanks of the Euphrates. Mr. Niebuhr also places them among the animals of Arabia; but their proper country is Africa, where their sizo is the largest, their numbers greatest, and their rago more tremendous, being inflamed by the influence of a burning sun upon a most arid soil. Dr. Fryer says that thoso of India are feeble and cowardly. In the interior parts, amidst the scorched and desolate deserts of Zaara, or Biledulgerid, they reign sole masters; they lord it over every beast, and their courage never meets with a check, where the climate keeps mankind at a distance; the nearer they approach the inhabitants of the human race, the less their rago, or rather the greater is their timidity: they have often experienced tho unequal combat, and finding that there exists a being superior to them, commit their ravages with more caution. A cooler climate again has the same effect; but in the burning deserts, where rivers and fountains are denied, they live in a perpetual fever—a sort of madness fatal to every animal they meet with."

Dr. Leach raised the form to the rank of a genus under the name of *Leo*.

M. Lesson, in his 'Manuel' (1827), gives four varieties, namely, the lion of Barbary, the lion of Senegal, the lion of Persia or Arabia, and the lion of the Cape.

Cuvier ('Règne Animal,' 1829) places at the head of the great genus *Felis*, "Le Lion (*Felis Leo*, Linn.)," and describes it as distinguished by its uniform yellow colour, the tuft of hair at the end of the tail, and the mane which covers the head, neck, and shoulders of the male. "It is," continues Cuvier, "the strongest and the most courageous of the animals of prey. Spread, at one time, over all the parts of the ancient world, it would appear at the present day nearly confined to Africa and some neighbouring parts of Asia."

M. Temminck, in his 'Monograph,' includes three varieties under *Felis Leo*, namely, the lions of Barbary, Senegal, and Persia, and these are retained in Dr. Fischer's 'Synopsis.'

Mr. Bennett ('Tower Menagerie,' 1829) notices the Bengal Lion, the Cape Lion, and the Barbary variety (figuring the two former), and observes upon their distinctions.

Sir William Jardine ('Naturalists' Library,' '*Mammalia*,' vol. ii., *Felinæ*, 1834), in addition to other plates, has given a figure of the Asiatic variety from a specimen in the Surrey Zoological Gardens, and, after noticing that the lions of Africa and India have been described as varieties, states his strong suspicions that future observations will prove these animals to be in reality distinct species, and notices them separately under the names of *Leo Africanus* and *Leo Asiaticus*; he also alludes to the Maneless Lion.

Mr. Swainson ('Classification of Quadrupeds,' 1835) places the African Lion (*Leo Africanus*, Sw.) at the head of the *Felidæ*. In his arrangement at the end of the volume he notices the form under the designation of "*Leo Antiquorum* (Lions). Head and neck furnished with a mane of long hair; tail tufted." The next genus, *Felis L.* (Cats), he characterises thus: "No mane; tail long, not tufted." In his 'Animals in Menageries,' 1838, the Lion does not appear to be noticed.

Of the African Lions Temminck notices two varieties—that of Barbary and that of Senegal. M. Lesson adopts these two varieties, and adds the Lion of the Cape, of which he gives two varieties.

The Lion of Barbary.—This lion is described as having a deep yellowish-brown fur, and the mane of the male is stated to be very much developed.

The Lion of Senegal is characterised by a fur of a more yellow tint, the mane in the male being less thick, and nearly wanting upon the breast and insides of the legs.

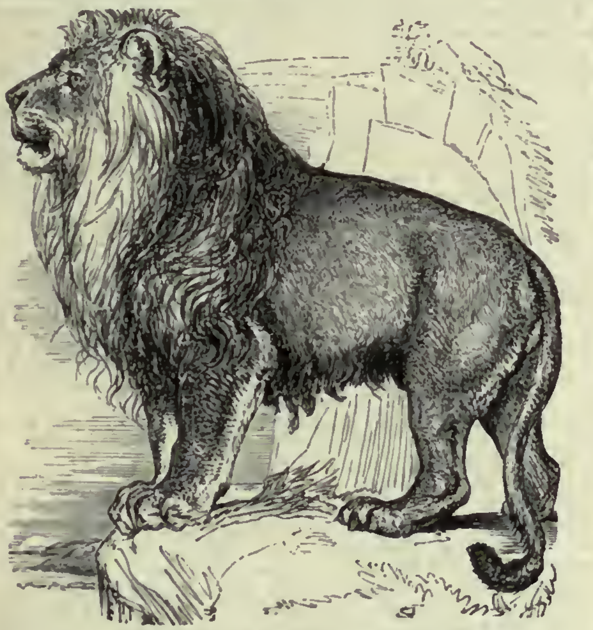
The Lion of the Cape presents two varieties, one yellowish and the other brown: the latter is regarded as the most ferocious and formidable. The Dutch colonists speak of the "blue and the black" kinds, and it seems indeed that there is a black-maned lion, one of which, accompanied by his lioness, Mr. Burchell appears to have encountered in his travels in Africa.

Mr. Burchell well observes, that 'King of the Forest' is a title not very applicable to an animal which he at least never met but on the plains; nor did he ever meet with one in any of the forests where he had been. The low cover that creeps along the sides of streams, the patches that mark the springs, or the rank grass of the valley, seem to be the shelter which the African Lion for the most part seeks. Of the strength of this variety we have most extraordinary examples on record. To carry off a man—and there are dismal accounts of this horrible fact, which there is no reason to doubt—appears to be a feat of no difficulty to this powerful brute. Indeed, when we find that a Cape lion seized a heifer in his mouth, and, though the legs dragged upon the ground, seemed to carry her off with the same ease as a cat does a rat, leaping over a broad dike with her without the least difficulty—that another, and a young one too, conveyed a horse about a mile from the spot where he had killed it—and that a third, which had carried off a two-year old heifer, was followed on the spoor, or track, for five hours by horsemen, when it appeared that throughout the whole distance the carcass of the heifer was only once or twice discovered to have touched the ground (Sparrman)—the asportation of a man shrinks into insignificance as a demonstration of strength. There seems to be an idea that the Lion prefers a human prey; but be this as it may, the inhabitants of certain districts have, it appears, been under the necessity of resorting to a curious expedient to get out of their reach. Messrs. Schoon and M'Luckie, in 1829, penetrated to the eastward of Kurrichaine, situated about 200 miles to the north-east of Litakou. They discovered, east of Kurrichaine, or Chuan, as it is more properly named, the river Moriqua, which rises in the south between the 25th and 26th degrees of latitude, and 29th and 30th degrees of longitude, taking a north-easterly course, and about 100 miles from the ford enters a high ridge of mountains. From hence, according to the natives, it flows into the sea, through the country of the Mantatees. About 70 miles to the eastward, the range of mountains takes a direction north and south. At the distance of 14 miles to the south, along the base of the mountains, is a place called Ongo-rutcie-Fountain, where there is a large tree containing seventeen conical huts. These are used as dormitories, being beyond the reach of the lions, which, since the incursion of the Mantatees, when so many thousands of persons were massacred, have become very numerous in the neighbourhood, and destructive to human life. The branches of these trees are supported by forked sticks or poles, and there are three tiers or platforms, on which the huts are constructed. The lowest is nine feet from the ground, and holds ten huts; the second, about eight feet high, has three huts; and the upper story, if it may be so called, contains four. The ascent to these is made by notches cut in the supporting poles, and the huts are built with twigs, thatched with straw, and will contain two persons conveniently. The travellers had previously visited several deserted villages, similarly built, between the Moriqua and Leutlecan rivers, as well as in other places; but these were erected on stakes about eight feet above the ground and about forty feet square, larger in some places, and containing about seventy or eighty huts. The inhabitants sit, it is stated, under the shade of these platforms during the day, and retire to the elevated huts at night.*

The general prey of the African Lion consists of the larger herbivorous quadrupeds, very few of which it is unable to master, and it is a severe scourge to the farmer, who is consequently ever on the look-out for lions, and generally a most imperturbable and unerring shot. Though mortal accidents frequently happen in these huntings, the cool sportsman seldom fails in using his rifle with effect. Lions when roused, it seems, walk off quietly at first, and if no cover is near, and they are not pursued, they gradually mend their pace to a trot, till they have reached a good distance, and then they bound away. Their demeanour upon these occasions has been described to us by eye-witnesses to be of a careless description, as if they did not want a fray, but if pressed were ready to fight it out. If they are pursued closely, they turn and couch, generally with their faces to the adversary; then the nerves of the sportsman are tried. If he is collected and master of his craft, the well-directed rifle ends the scene at once; but if, in the flutter of the moment, the vital parts are missed, or the ball passes by, leaving the lion unhurt, the infuriated beast frequently charges on his enemies, dealing destruction around him. This however is not always the case, and a steady unshrinking deportment has, in more instances than one, saved the life of the hunter. Mr. Burchell gives an interesting account in his African travels of his confronting one of these animals. "The day was exceedingly pleasant, and there was not a cloud to be seen. For a mile or two, we travelled along the banks of the river, which, in this part, abounded in tall mat-rushes. The dogs seemed much to enjoy prowling about, and examining every bushy place, and at last met with some object among the rushes which caused them to set up a most vehement and determined barking. We explored the spot with caution, as we suspected, from the peculiar tone of their bark, that it was what we suspected it to be,—lions. Having encouraged the dogs to drive them out, a task which they performed with great willingness, we had a full view of an enormous black-maned lion and lioness. The latter was seen only for a minute, as she made her escape up the river, under the concealment of the rushes; but the lion came steadily forward, and stood still to look at us. At this moment we felt our situation not free from danger, as the animal seemed preparing to spring upon us, and we were standing on the bank, at the distance of only a few yards from him, most of us being on foot and unarmed, without any visible possibility of escaping. I had given up my horse to the hunters, and was on foot myself; but there was no time for fear, and it was useless to attempt avoiding him. . . . I stood well upon my guard, holding my pistols in my hand, with my finger upon the trigger; and those who had muskets kept themselves prepared in the same manner. But at this instant the dogs boldly flew in between us and the lion, and surrounding him, kept him at bay by their violent and resolute barking. The courage of those faithful animals was most admirable: they advanced up to the side of the huge beast, and stood making the greatest clamour in his face, without the least appearance of fear. The lion, conscious of his strength, remained unmoved at their noisy attempts, and kept his head turned towards us. At one moment, the dogs perceived his eye thus engaged, had advanced close to his feet, and seemed as if they would actually seize hold of him; but they paid dearly for their impudence, for, without discomposing the majestic and steady attitude in which he stood fixed, he merely moved his paw, and, at the next instant, I beheld two lying dead. In doing this he made so little exertion, that it was scarcely perceptible by what means they had been killed. Of the time which we gained by the interference of the dogs, not a moment was lost: we fired upon him; one of the balls went through his side, just between the short ribs, and the blood began to flow, but the animal still remained standing in the same position. We had now no doubt that he would spring upon us: every gun was instantly reloaded; but happily we were mistaken, and were not sorry to see him move quietly away, though I had hoped in a few minutes to have been enabled to take hold of his paw without danger." Even where the hunter has been

* See 'South African Journal,' September, 1830; and Steedman's 'Wanderings and Adventures in the Interior of Southern Africa, where the reader will find a drawing of the inhabited tree above described, taken by Mr. Moffat of Litakou, who also visited this spot.

seized with a panic and pursued, a timely recovery of self-possession has saved him. Sparrman relates that Jacob Kok of Zee-Koe-Rivier, one day walking over his lands with his loaded gun, unexpectedly met a lion. Being an excellent shot, he thought himself pretty certain, from the position in which he was, of killing it, and therefore fired his piece. Unfortunately he did not recollect that the charge had been in it for some time, and consequently was damp; so that his piece hung fire, and the ball falling short, entered the ground close to the lion. In consequence of this he was seized with a panic and took directly to his heels; but being soon out of breath and closely pursued by the lion, he jumped up on a little heap of stones, and there made a stand, presenting the butt end of his gun to his adversary, fully resolved to defend his life as well as he could to the utmost. This deportment had such an effect on his pursuer, that he also made a stand, and lay down at the distance of a few paces from the heap of stones seemingly quite unconcerned. Jacob, in the mean time, did not stir from the spot; besides he had in his flight unfortunately dropped his powder-horn. At length, after waiting a good half-hour, the lion rose up, and at first went very slowly, and step by step only, as if he had a mind to steal off; but as soon as he got to a greater distance, he began to bound away at a great rate. There is hardly a book of African travels which does not teem with the dangers and hair-breadth escapes of the lion-hunters, and hardly one that does not include a fatal issue to some engaged in this hazardous sport; but our limits will not allow us to enter into further details on this part of the subject, and we must refer to such works for accounts—and they are very interesting—of the different modes of destruction employed against this powerful beast, from the poisoned arrow of the Bushman to the rifle of the colonist.



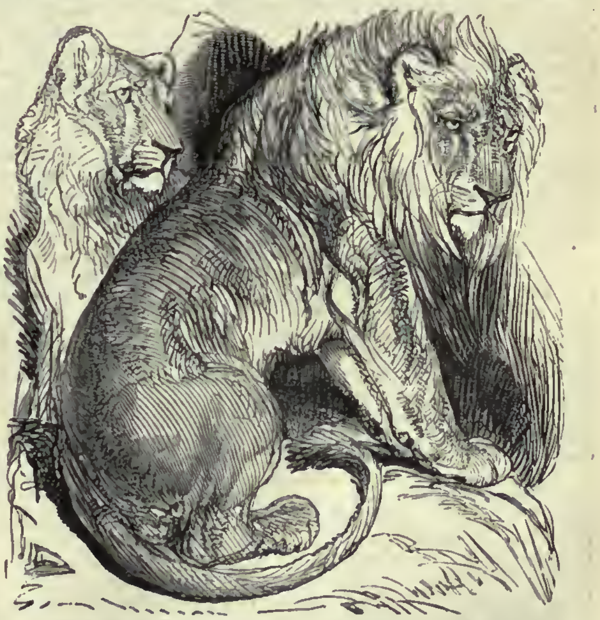
Africaa Lion (*Leo Africanus*). (Barbary.)

The following extracts from an anonymous work entitled 'Zoological Anecdotes' embody some of the observations made by Mr. Cuming, whose collection of stuffed animals from Africa were so long exhibited at Hyde Park Corner:—

"The following powerfully-drawn picture conveys a most accurate idea of the fearful banquets held in the primæval forests of Africa, and at the same time is full of interest from the light it throws on the habits of the *Carnivora*. Mr. Cuming had shot three rhinoceroses near a fountain, and soon after twilight had died away he came down to the water to watch for lions. With him was his Hottentot Kleinboy. 'On reaching the water I looked towards the carcass of the rhinoceros, and to my astonishment I beheld the ground alive with large creatures, as though a troop of zebras were approaching the water to drink. Kleinboy remarked to me that a troop of zebras were standing on the height. I answered 'Yes;' but I knew very well that zebras would not be capering around the carcass of a rhinoceros. I quickly arranged my blankets, pillow, and guns in the hole, and then lay down to feast my eyes on the interesting sight before me. It was bright moonlight, as clear as I need wish. There were six large lions, about twelve or fifteen hyænas, and from twenty to thirty jackalls, feasting on and around the carcasses of the three rhinoceroses. The lions feasted peaceably, but the hyænas and jackalls fought over every mouthful, and chased one another round and round the carcasses, growling, laughing, screeching, chattering, and howling, without any intermission. The hyænas did not seem afraid of the lions, although they always gave way before them; for I observed that they followed them in the most disrespectful manner, and stood laughing, one or two on either side, when any lions came after their comrades to examine pieces of skin or bones which they were dragging away.' The following account of an attack by one of these man-eaters, as they are called (for having once tasted human flesh they will eat nothing else if it can be obtained), makes the blood run cold. Mr. Cuming and his party had, unknown to them, pitched their camp in the proximity of a lion of this description. All had retired to rest, when (says Mr. C.) 'suddenly the appalling and murderous voice of an angry bloodthirsty lion burst upon my ears within a few yards of us, followed by the shrieking of the Hottentots. Again and again the murderous roar of attack was repeated. We heard John and Ruyter shriek, 'The lion! the lion!' Still for a few moments we thought he was but chasing one of the dogs round the kraal, but the next instant John Stofulus rushed into the midst of us, almost speechless with fear and terror, his eyes bursting from their sockets, and shrieked out, 'The lion! the lion! He has got Hendrick! He dragged him away from the fire beside me. I struck him with the burning brands upon his head, but he wouldn't let go his hold. Hendrick is dead! O God! Hendrick is dead! Let us take fire and seek him.' The rest of my people rushed about shrieking and yelling as if they were mad. I was at once angry with them for their folly, and told them that if they did not stand still and keep quiet the lion would have another of us, and that very likely there was a troop of them. I ordered the dogs which were nearly all fast to be made loose, and the fire to be increased as far as could be. I then shouted Hendrick's name; but all was still. I told my men that Hendrick was dead, and that a regiment of soldiers could not now help him; and hunting my dogs forward, I had everything brought within my cattle kraal, when we lighted our fire and closed the entrance as well as we could. It appeared that when the unfortunate Hendrick rose to drive in the ox the lion had watched him to his fireside, and he had scarcely lain down when the brute sprang upon him and Ruyter (for both lay under one blanket) with his appalling murderous roar; and roaring as he lay, grappled him with his fearful claws, and kept biting him on the breast and shoulder, all the while feeling for his neck; having got hold of which, he at once dragged him away backwards round the bush into the dense shade. As the lion lay on the unfortunate man he faintly cried, 'Help me! help me! O God! men, help me!' After which the fearful beast got hold of his neck, and then all was still, except that his comrades heard the bones of his neck cracking between the teeth of the lion.' It is satisfactory to know that on the following day Mr. Cuming took revenge on the lion, whose huge grisly hide is to be seen in his collection at Hyde Park Corner."

Of Asiatic Lions three kinds are mentioned—the Bengal Lion, the Persian or Arabian Lion, and the Maneless Lion of Guzerat.

The Bengal Lion.—Mr. Bennett points out the characteristics by which the Asiatic race is distinguished from that of Southern Africa, as consisting principally in the larger size, the more regular and graceful form, the generally darker colour, and the less extensive mane of the African. He gives a beautiful cut of the Bengal Lion, executed by Harvey, in the 'Tower Menagerie,' from a very fine specimen little more than five years old, then in that collection, but called by the keepers 'The Old Lion.' The magnificent development of the mane is very striking in this figure.



Lion (mane not quite fully developed) from Eastern Asia, with Lioness.

The Persian or Arabian Lion.—This is stated to be distinguishable by the pale Isabella colour of the fur, and those which have been exhibited in England as Persian Lions certainly bear out this remark; but Captain Smee observes that the Persian Liou formerly exhibited at the Surrey Zoological Gardens seemed to him to differ but little from individuals known to be brought from Africa.

Persian Lion.

The Maneless Lion of Guzerat.—The reader will bear in mind the passage quoted from Pliny (viii. 16), touching lions which have no mane, and of the origin attributed to them. Cuvier notices the statement that maneless lions had been found on the confines of Arabia, and merely refers to Olivier, observing that there is no detailed description given of them. A zoological description is doubtless not to be found in Olivier; but he enters somewhat minutely into the subject, as the reader will here see. "The lion," says Olivier ('Voyage dans l'Empire Othoman, l'Egypte, et la Perse,' tom. iv.), "which inhabits the part of Arabia and Persia near the river of the Arabs, from the Persian Gulf to the environs of Helle and of Baghdad, is probably the species of lion of which Aristotle and Pliny have spoken, and which they regarded as a different species from that which is spread over the interior of Africa. The Liou of Arabia has neither the courage, nor the stature, nor even the beauty of the other. When he would seize his prey he has recourse to cunning rather than force; he crouches among the reeds which border the Tigris and Euphrates, and springs upon all the feeble animals which come there to quench their thirst; but he dares not to attack the boar, which is very common there, and flies as soon as he perceives a man, a woman, or even a child. If he catches a sheep, he makes off with his prey; but he abandons it to save himself, when an Arab runs after him. If he is hunted by horsemen, which often happens, he does not defend himself unless he is wounded and has no hope of safety by flight. In such a case he will fly on a man, and tear him to pieces with his claws, for it is courage more than strength that he wants. Achmed, pasha of Baghdad from 1724 to 1747, would have been torn by one after breaking his lance in a hunt, if his slave Suleiman, who succeeded him in the pashalik, had not come promptly to his succour, and pierced with a blow of his yataghan the lion already wounded by his master."

"We saw," continues Olivier, "five individuals of this race in the menagerie of the pasha of Baghdad; they had been there five years, and had been taken young in the environs of Bassora. There were three males and two females; the former were a little larger than the latter; and all much resembled the African species, excepting that they were smaller, and had no mane. We were assured that they never had any, and that no lion of those countries had one. We have often regretted that we did not ask the pasha for two of them, in order to a close comparison with the African species, and to satisfy ourselves whether the Lion of Arabia ought to be regarded as a species distinct from the other, or as a degenerated race."

In December 1833, Captain Walter Smee exhibited to a meeting of the Zoological Society of London the skins of a lion and lioness killed by him in Guzerat, and selected from eleven obtained there by him, eight of which he had brought to this country. This lion, he stated, is distinguished from those previously known by the absence of a mane (that is, it is maneless as compared with other lions) from the sides of the neck and shoulders, the middle line of the back of the neck being alone furnished with longer hairs, which are erect, like those in the same situation in the Cheetah (*Felis jubata*). The under surface of the neck has long loose silky hairs, and there is a tuft at the angle of the anterior legs. Besides the absence of the extensive mane, the tail is shorter than that of ordinary lions, and is furnished at its tip with a much larger brush or tuft. In this tuft there existed in the oldest of Captain Smee's lions, subsequently to the arrival of the skin in England, a short horny claw or nail, similar in form to, but somewhat larger in size than that described by Mr. Woods, and above alluded to.

Captain Smee, ('Transactions of the Zoological Society,') enters into a very minute description of the arrangement of the hair in this variety, both in the male and the female, observing that both the African and Guzerat Lion are subject to considerable variations in intensity of colouring. In both the colour is fulvous; but in some individuals, he says, this is much paler than in others, and in the darker specimens there occurs a tinge of red. The middle of the back is the most deeply coloured part, and the under surface is much paler and almost white. Among the hairs there is an intermixture of some which are entirely black, and the greater or less proportion which these bear to the paler ones is the principal cause of the variations in depth of colour that occur in different individuals. Of the Guzerat Lions the oldest individual is the lightest in colour. The tail becomes gradually paler towards its extremity, passing into grayish white; its terminal brush consisting of black hairs slightly tinged with brown. Above each eye is a pale space, in which is included a darker-coloured spot for the implantation of the supraciliary vibrissæ, from twelve to fifteen in number, and of which the longest reaches nearly to the ears. In the African Lion these vibrissæ are implanted in a darker spot, but this spot is less defined, and is only partially bounded by a paler space. In both the points of insertion of the moustaches are darker than the surrounding parts. Captain Smee does not speak with certainty of the comparative form of these two varieties; but he states his impression to be that the Liou of Guzerat is comparatively more rounded and bulky in its body, and rather shorter in its limbs; and that its head especially is shorter, has less of the square form which distinguishes the open face of the male African Lion, and is more rounded on the forehead. But, as he observes, this difference may be chiefly owing to the long hairs which conceal the forehead in the one, while that feature is defined and visible in the other. The cranium of the Lion of Guzerat generally resembles that of the African race. Professor Owen had remarked that the infra-orbital foramina were double in the only lions known to be Asiatic examined by him; in one, killed in North Guzerat, this occurs on both sides; in the other, killed near Assund, it is found on one side only. Captain Smee states that in a young skull of the Maneless Lion there exists on one side a double infra-orbital foramen, and that the existance of the same structure in another skull contained in one of the skins had been ascertained. A male Maneless Lion killed by Captain Smee measured, including the tail, 8 feet 9½ inches in length, and his total weight, exclusive of the entrails, was 35 stone (14 lbs. to the stone); the impression of his paw on the sand measured 6¼ inches across, and his height was 3 feet 6 inches. A female killed at the same time was 8 feet 7 inches long and 3 feet 4 inches high.

These Maneless Lions are, according to the author last quoted, found in Guzerat along the banks of the Sombermuttee near Ahmedabad. During the hot months they inhabit the low bushy wooded plains that skirt the Bhardar and Sombermuttee rivers from Ahmedabad to the borders of Cutch, being driven out of the large adjoining tracts of high grass jungle (called Bheers) by the practice annually resorted to by the natives of setting fire to the grass, in order to clear it and ensure a succession of young shoots for the food of the cattle upon the first fall of the rains. They extend through a range of country about 40 miles in length, including various villages, and among others those of Booroo and Goliaua, near which Captain Smee killed his finest specimens. They were so common in this district that he killed no fewer than eleven during a residence of about a month; yet scarcely any of the natives, except the cattle-keepers, had seen them previously to his coming among them. The cattle were frequently carried off or destroyed, but this they attributed to tigers. Captain Smee however observes, that the tiger does not exist in that part of the country. Those natives to whom the lions were known gave them the name of Ontiah Baug, or Camel-Tiger, an appellation derived from their resemblance in colour to the camel. They appear to be very destructive to the domesticated cattle, and the remains of a considerable number of carcasses of bullocks were found near the place where Captain Smee's specimens were killed. About ten days previously, four donkeys had been destroyed at the village of Cashwah. Captain Smee could not learn that men had been attacked by them. When struck by a ball, they exhibited great boldness, standing as if preparing to resist their pursuers, and then going off slowly and in a very sullen manner; unlike the tiger, which on such occasions retreats springing and snarling. Captain Smee states that these lions are also found on the Runn near Runpoor, and near Puttun in Guzerat, and that some persons who saw them in Bombay said that they also occur in Sinde and in Persia. He further observes, that should subsequent inquiries prove that Olivier was correctly informed as to the locality from which the Maneless Lions seen by him at Baghdad were obtained, and prove also their identity with those of Guzerat, a more extensive geographical range will be established for this curious race than Captain Smee is at present disposed to regard as probable.

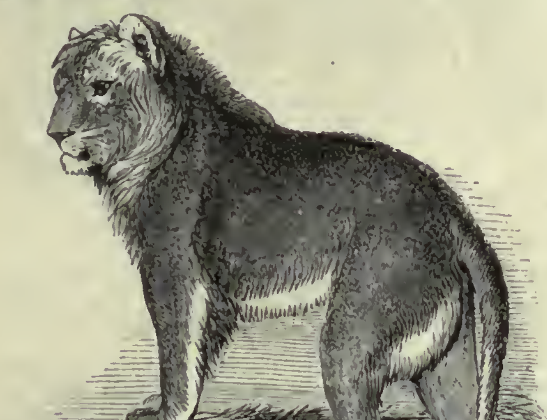
Captain Smee remarks that he is aware that the existence of these Maneless Lions in Guzerat had been previously although by no means generally known, and quotes Colonel Sykes as having this knowledge. Sir Charles Malet had also seen lions on the banks of the Sombermuttee, and though he makes no mention of the absence of the mane, Captain Smee thinks that they in all probability belonged to this maneless race, and indeed Sir Charles attributes to his lion the native name noticed by Captain Smee above.

Our author makes the following remarks on the passages to be found in the ancient writers bearing on this subject : "Having alluded in the commencement of this communication, to the opinion that a maneless lion was known to the ancients, it might be expected that I should here bring forward and discuss the several passages which have been looked upon as supporting this view. Where however the critics are at fault, it would be presumptuous in me to attempt to decide. I own that I do not find in the passages usually referred to any evidence at all satisfactory as regards the existence of lions destitute of mane; and I am even far from willing to admit that the crisped hairs noticed by Aristotle as distinguishing one race of lions from another, in which the hairs were either dense or straight, must of necessity be considered as those of the mane rather than of any other part of the body. The language of Oppian is equally obscure, and even the expressions used by him are warmly contested by the critics. Another Greek writer, Agatharchides, the Peripatetic, speaks of the Arabian and especially the Babylonish Lions, in terms that recall Olivier's description of those of Baghdad, but still with no definite application to the want of a mane. Pliny alone, so far as I am aware, mentions the absence of mane as a distinctive mark of one race of lions; but to this race he attributes a monstrous generation, and he was probably altogether misled with respect to it."

We may here remark that a maneless lion is said to be represented on the monuments of Upper Egypt.

Captain Smee thus characterises his Maneless Lion :—

Felis Leo, Linn., var. *Goojratensis*.—Mane of the male short, erect; tuft at the apex of the tail very large, black. ('Zool. Proc.,' 1833; and also 'Zool. Trans.,' vol. i.)



Maneless Lion of Guzerat.

The habits of the Asiatic Lions do not differ much from those of Africa, excepting that the former, from the state of the country frequent jungles. In India the elephant is generally employed in the chace, which is even now conducted with more pomp and circumstance than in Africa. The grand Asiatic huntings of former times, those of Genghis Khan for instance, will occur to many of our readers. The accounts of most Asiatic modern sportsmen give a most courageous bearing to the lions in these encounters. One of these states that the lions in India, instead of running away when pursued through a jungle, seldom take to cover as a refuge at all. On the approach of their enemies, they spring out to meet them open-mouthed in the plain. They are thus easily shot; but if they are missed or only slightly wounded, they are most formidable adversaries. They are even said to have sprung on the heads of the largest elephants, and to have fairly pulled them to the ground, riders and all.

The lioness is said to go with young five months, and produces generally from two to three or four at a litter, which are born blind. Three, two males and a female, were whelped in the Tower on the 20th October 1827, the day of the battle of Navarino; but the number seems generally to be two. In captivity the lioness usually becomes very savage as soon as she becomes a mother; and in a state of nature both parents guard their young with the greatest jealousy. Mr. Bennett relates that in the commencement of the year 1823, General Watson, then on service in Bengal, being out one morning on horseback armed with a double-barrelled rifle, was suddenly surprised by a large male lion, which bounded out upon him from the thick jungle at the distance of only a few yards. He instantly fired, and the shot taking complete effect, the animal fell dead almost at his feet. No sooner had the lion fallen than the lioness rushed out, which the general also shot at, and wounded severely, so that she retired into the thicket. Thinking that the den could not be far distant, he traced her to her retreat, and there dispatched her, and in the den were found two beautiful cubs, a male and a female, apparently not more than three days old. These the general brought away; they were suckled by a goat and sent to England, where they arrived in September 1823, as a present to George IV., and were lodged in the Tower. The male was the animal from which Mr. Bennett gives his figure and description of the Bengal Lion, and the female was the mother of the cubs whelped in the Tower, above alluded to. ('Tower Menagerie.') The young are at first obscurely striped, or brindled, and somewhat tiger-like in the coat. There is generally a blackish stripe extending along the back, from which numerous other bands of the same colour branch off, nearly parallel to each other on the sides and tail. The head and limbs are generally obscurely spotted. When young they mew like a cat; as they advance the uniform colour is gradually assumed, and at the age of ten or twelve months the mane begins to appear in the males; at the age of eighteen months this appendage is considerably developed, and they begin to roar. (Bennett.) F. Cuvier states that it is nearly the third year before the mane and the tuft on the tail appear, and that they are not fully developed before the seventh or eight year. It should however be borne in mind that the Bengal Lion mentioned by Mr. Bennett, and figured by him, was magnificently maned, and he was little more than five years old. The period of shedding the milk-teeth is very often fatal to the young animals in a state of captivity. The natural period of a lion's life is generally supposed to be 20 or 22 years. Such is Buffon's limitation, but the animal will it seems live much longer. Pompey, the great lion which died in 1760, was said to have been in the Tower above 70 years; and one from the river Gambia is stated to have since died there at the age of 63.

The lion, from its power and supposed generosity of disposition, has been popularly hailed as the King of Beasts, and considered as the emblem of majesty and might. It is the symbol of the British nation, and is borne in the royal arms, of which it forms one of the supporters, and which it surmounts as the crest. Captain Smee remarks, in allusion to the hybrid mentioned by Pliny, that it is by no means improbable that the maneless feline beast which occurs in the older armorial bearings may have been intended to represent a lion leoparded. This term, he observes, is still in use among the heralds of France, but is employed by them with reference only to the position of the head; if the full face is shown, the animal, whether maned or maneless, is in their language a leopard; if the side face alone is seen, it is a lion. Hence with them the lions passant and gardant of the arms of the kings of England would be either lions leoparded or leopards maned. He goes on to state that the omission of the mane, in rude tricking, would indeed reduce them to leopards, and as such they were originally regarded. The emperor Frederic II., in choosing his present of three leopards to our Henry III., was actuated, according to Matthew Paris, by the bearing in the royal shield of England, "in quo tres leopardi transeuntes figurantur." ('Zool. Trans.')

The generosity of disposition so liberally accorded to this powerful beast has been much and eloquently praised. It seems almost sacrilegious to dissipate the glowing vision which Buffon has raised; but if there is any dependence to be placed on the observations of those travellers who have had the best opportunities of judging, and have the highest character for veracity, we must be compelled to acknowledge that Buffon's lion is the lion of poetry and prejudice, and very unlike the cautious lurking savage that steals on its comparatively weak prey by surprise, overwhelms it at once by the terror, the weight, and the violence of the attack, and is intent only on the gratification of its appetites. "At the time," says Mr. Burchell, "when men first adopted the lion as the emblem of courage, it would seem that they regarded great size and strength as indicating it; but they were greatly mistaken in the character they had given of this indolent animal." The fact of the lion sparing the dog that was thrown to him, and making a friend of the little animal that was destined for his prey, has been much dwelt on; but these and other such acts of mercy, as they have been called, may be very easily accounted for. If not pressed by hunger, the lion will seldom be at the trouble of killing prey; and the desire for a companion has created much stronger friendships between animals in confinement than that between a lion and a little dog.

The lion is easily tamed, and capable of attachment to man. The story of Androdus, frequently called Androcles, is too well known to need more than allusion, and we learn from Bell's 'Travels' that the monarch of Persia had on days of audience two great lions chained on each side of the passage to the state-room, led there by keepers in golden chains. Every wild-beast show almost has its tame lion, with which the keeper takes the greatest liberties—liberties which the beast will suffer, generally speaking, from none but him. All these exhibitions however were entirely eclipsed by the feats of Mr. Van Amburgh, who exercised a complete control over the lions and other great *Felidæ* which he had subjected to his will. The imitators of Van Amburgh however have not been so successful, and instances have occurred in which persons have forfeited their lives by their temerity. An instance of this kind occurred a few years ago in England, in which a young woman, who was called the Lion Queen, lost her life in this way.

Hybrids.—The Lion and Tigress will, under certain circumstances, produce young. This has happened twice in England. Sir William Jardine gives the figure of one of a litter so bred, and exhibited in Atkins's collection, where they were whelped, in 1827: they died young. Sir William Jardine correctly describes the colour of the whelps as brighter than that of the Lion, and the bands as better marked than they generally are in the true-bed young lion. The specimen figured by Sir William is in the Edinburgh Museum. Another litter from similar parents was whelped at Windsor; but these also died before they came to maturity. There does not seem to be much difficulty in promoting this union.

Lion-Tiger Cubs.

The Puma, or American Lion.—The uniformity of colour in this great cat, combined with considerable ferocity, were probably the reasons which induced early travellers in America, who heard of it perhaps with circumstances of exaggeration, or caught hasty glimpses of it not unaccompanied with terror, to state that there were lions in America. Thus John de Laet (1633) says, that lions are found in Peru, though they be few, and not so ferocious as they are in Africa, and that they are called in the native tongue Puma. In an old tract (1649), entitled 'A Perfect Description of Virginia,' we find among the "beasts great and small," "Lyons, Beares, Leopards, Elkes," &c.; and Garcilasso tells us of the Puma, or Lion of Peru. In Hernandez (Romæ, 1651) there is a long account of the animal under the name of 'Puma, seu *Leo Americanus*;' and reasons are given to show that it is not a true lion. In Piso the animal is noticed as the Cuguacuara, and by Marcgrave as the Cuguacurana of the Brazilians; hence the French name Couguar. Charlevoix describes it clearly enough under the name of Carcajou, or Quincajou; this name Pennant thinks that Charlevoix gives by mistake. In d'Azara's Gouazouara of Paraguay we again trace the French name of this animal. Lawson and Catesby both describe it under the name of the Panther, by which designation it is known to the Anglo-Americans up to this day. It is the *Felis concolor* of Schreber and of zoologists generally, and though Linnæus is often quoted as the author of the name, it will not be found in his last edition of the 'Systema Naturæ.' In Gmelin's edition it appears as *Felis concolor* (an error for *concolor*), with Schreber's description. It is the *Felis Puma* of Traill.

The reader will find in the 'Proceedings of the Zoological Society of London' a detailed account of the dissection of a Puma that died at the Society's Garden. In one point the Puma differs considerably from other cats. This point is that part of the structure which is connected with the organs of voice, and, as Mr. Martin observes, some according modification must necessarily produce the deep-toned roar of the Lion, the snarl of the Jaguar, and the hissing cry of the Puma. "The distance between the tongue and the larynx in the Lion," says Mr. Martin, "has been brought more than once under the notice of the society; in the Jaguar this distance, comparatively speaking, is nearly as great; but in the Puma, an animal equal, or nearly so, in size to the Jaguar, the distance is reduced to an inconsiderable space, an inch or an inch and a half, according as the tongue is more or less protruded. In addition to this it is worthy of observation that the circumference of the larynx in the Puma is also very inconsiderable; compare, for example, the larynx of the Jaguar with that of the present animal, both natives of the wilds of the American continent. In the Jaguar we find a larynx indicating, from its general magnitude, considerable depth in the intonations of the voice; whereas in the Puma, if we take either its diameter or its distance from the termination of the palate and base of the tongue, we are led to expect neither the roar of the Lion nor the growl of the Jaguar, but the shrill tones of an animal, ferocious indeed, but of all others of the genus perhaps the most stealthy and insidious."

The adult male has no mane. Silvery fawn above, sometimes reddish, the tawny hairs of the upper parts whitish at the tips; nearly white beneath, and on the inside of the limbs, whitish on the throat, chin, and upper lip. Head black and gray irregularly mixed; ears on the outside, and particularly at their base, sides of the muzzle, whence the whiskers spring, and end of the tail (which has no tuft), black. Length from nose to tail about 4 feet; tail rather more than 2 feet. Female coloured like the male. Head small when compared with his.

Young.—Back marked with three chains of spots, which are generally of a blackish-brown; dispersed spots or markings on the neck, shoulders, and sides. As the animal advances in age these markings become more and more obscure, till they are at last lost in the uniform colour.

A specimen of a young Puma, exhibited at a meeting of the Zoological Society in 1831, was, like the young of the other species of *Felis*, variously spotted and striped, the depth of its markings approaching nearly to black, and being more intense than that observed in the Lion. The muzzle was nearly black, as was also the greater part of the tail. This young one had been recently brought forth at the Society's Garden, but died immediately; it was strongly contrasted with a specimen of the adult placed on the table for comparison.

This animal is found in North and South America. There is reason to think that it was formerly to be found from Canada to Patagonia, with an extensive range to the east and west, but its geographical area has been very much diminished, and is daily becoming more and more contracted before that civilisation which is in our own times obliterating more species than one. Mr. Washington Irving ('Astoria') mentions it as being about the mouth of the Columbia River.

Lawson (Carolina) gives the following characteristic account of the Puma. "The Panther is of the cat's kind; about the height of a very large grayhound, of a reddish colour, the same as a Lion. He climbs trees with the greatest agility imaginable, is very strong-limbed, catching a piece of meat from any creature he strikes at. His tail is exceeding long, his eyes look very fierce and lively, are large, and of a grayish colour; his prey is swine's flesh, deer, or anything he can take; no creature is so nice and clean as this in his food. When he has got his prey he fills his belly with the slaughter, and carefully lays up the remainder, covering it very neatly with leaves, which if anything touches he never eats any more of it. It purrs as cats do; if taken young, is never to be reclaimed from his wild nature. He hollows like a man in the woods when killed, which is by making him take a tree, as the least cur will presently do; then the huntsmen shoot him; if they do not kill him outright he is a dangerous enemy when wounded, especially to the dogs that approach him. This beast is the greatest enemy to the planter of any vermin in Carolina. His flesh looks as well as any shamble's meat whatsoever; a great many people eat him as choice food, but I never tasted of a panther, so cannot commend the meat by my own experience. His skin is a warm covering for the Indians in winter, though not esteemed among the choice furs. This skin dressed makes fine women's shoes or men's gloves."

We may here observe, without throwing doubt on other parts of Lawson's description, which is, generally speaking, confirmed by others, that, like many other writers, he has been too hasty in speaking of the irreclaimable nature of his animal. We can testify to the amiable qualities of the late Mr. Edmund Kean's 'Tom.' The Puma so called which belonged to this extraordinary actor was perfectly tame, and followed him about like a dog. Nor is this the only instance of the docility of this species. Mr. Bennett observes that in captivity the Puma readily becomes tame, and that his manners closely resemble those of the domestic cat; "like it," continues Mr. Bennett, "he is extremely fond of being noticed, raises his back and stretches his limbs beneath the hand that caresses him, and expresses his pleasure by the same quiet and complacent purring. They soon become attached to those with whom they are familiar; and numerous instances might be mentioned in which they have been suffered to roam almost at large about the house without any injurious results." ('Tower Menagerie.')

Charlevoix ('Journal,' vol. i.) gives a rather curious account of the Carcajou going a hunting with three foxes; and of his lying in wait on a tree for the elk, and leaping down upon him as he passes under.

It seems to be generally agreed that the Puma is a most destructive species; for when it meets with a herd of animals it will slay in all directions, sucking only a small portion of blood from each victim. To sheep, fifty of which it is said to have been known to kill in one night, it is most destructive, and the squatter well knows the ravages that it will make among his hogs. Though an expert climber, it is said to haunt in South America the marshy meadow-lands bordering on the rivers, rather than the forest. In the Pampas it must affect the comparatively open country; for there, as we shall presently see, it is commonly taken by the lasso. In the northern districts the swamps and prairies are its principal haunts; and its prey, where flocks and herds are not, deer principally, upon which it is said to drop in the manner described by Charlevoix with regard to the elk.

The chace of this animal is conducted, in different parts of the American continent, according to the prevailing manners of the people who go forth to hunt it. Thus Captain Head relates that as soon as the dogs unkennel a Lion (Puma) or Tiger (Jaguar) they pursue him until he stops to defend himself. If the dogs fly upon him, the Guacho jumps off his horse, and whilst he is engaged with the dogs, knocks him on the head with the balls; but if the dogs bay and do not go boldly in, the Guacho throws his lasso over him, and gallops off, dragging him along the ground, while the hounds rush upon him and tear him. In the north he generally falls by the rifle, after he is 'treed' by the hunting party. Audubon gives a most lively account of an expedition of this kind, headed by a squatter on the banks of the Coldwater River, which ended in the Puma's death. The 'cougar,' or 'panther,' as Audubon terms him, was driven 'to tree' twice, and each time received balls in that situation. Several go in company generally, for when the infuriated animal has had to deal with one hunter only, the consequences have been sometimes fatal to the latter.

Puma (*Felis concolor*).

Cuvier remarks, that as it would appear that this animal extends or did extend from California to Patagonia, he has been careful in his researches to discover whether there were not many species, or at least varieties, in this great extent of country; the conclusion at which he arrived was, that one species only existed.

The reader must bear in mind that there is another Cat of a uniform colour, *Felis unicolor*, Traill, which is said to inhabit the forests of Demerara, and is one-half less than the Puma. The Black Couguar (*F. discolor*), is allowed by some zoologists and rejected by others.

Sir William Jardine describes as the Black Puma an animal about 33½ inches long, without including the tail, which is about 13 inches, and of which he gives a figure taken from a specimen brought in a merchant vessel to Greenock. He gives as synonyms El Negro of D'Azara and the Black Cat of America (Griffith's 'Synopsis'), both with a note of interrogation. Sir William adopts Puma as a genus, and gives the following species:—*P. concolor, P. nigra, P. Yaguarundi, P. Eyra, P. Pajeros, and P. chalybeata.* Figures of *P. Yaguarundi* and *P. Pajeros* are given in the 'Zoology of the Voyage of H.M.S. Beagle,' edited by Mr. Darwin.

II. Tigers.

Although there is but one species of Tiger, properly so called, the Tiger-Cats, or those species of the genus *Felis* in which the tigerine character predominates, may be also treated of under the title before us.

The Royal Tiger, *Felis Tigris*, claims our first notice; and although poets and poetical zoologists have joined to elevate the lion with his majestic mane to the sovereignty, it may be doubted whether the Tiger is not the type of the ferocious and blood-thirsty genus *Felis*.

Some have thought that this species was but little known to the ancients; but, we think, with no sufficient grounds. The numerous passages in which the word *Tigris* (τίγρις) occurs in Greek and Latin authors leave little room for doubting this knowledge; and Hyrcania, with which it is so frequently associated by the Roman writers, is a locality well suited to what we now know of its geographical distribution.

When Aristotle ('Hist. Anim.,' viii. 28), treating of hybrid animals which spring from an intermixture of different races, says that people pretend that the dogs of India are bred from the Tiger (τοῦ τίγριος) and a bitch, not indeed at the first union, but at the third, we see no reason, considering the locality which he assigns to the *Tigris*, and the opportunities which the conquests of Alexander gave him of knowing the animals of India, why the word should be rendered otherwise than by Tiger in our present acceptation of the term. "The tiger," writes Pliny ('Nat. Hist.,' viii. 18), "is produced in Hyrcania and India;" following this up with an allusion to the 'tremendous swiftness' of the animal, and the strong attachment which the tigress, notwithstanding accidental exception, is known to manifest for her cubs. Again ('Nat. Hist.' vi. 20), he notices the Indian nations as abounding in wild tigers. Of course he does not omit the story of the origin of the Indian dogs from the Tiger, and the rejection of the two first litters as too ferocious, while the third is taken and brought up. ('Nat. Hist.,' viii. 40). But further, it is quite clear from the same authority, that the *Tigris* had been exhibited at Rome, and that Pliny and others well knew the distinction between that species and leopards and panthers. After mentioning the last two, and referring to an ancient decree of the senate that African beasts should not be imported, but stating that the tribune Cneius Aufidius caused a plebiscitum to be passed which permitted their importation for the Circensian games, he states the numbers brought first by Scaurus, and then by Pompey the Great and Augustus; adding that Augustus was the first who showed a tame tigress (tigrin) in a den at Rome, upon the dedication of the Theatre of Marcellus, during the consulship of Q. Tubero and Fabius Maximus, and that the emperor Claudius showed four together. ('Nat. Hist.,' viii. 17). Suetonius ('Aug.,' xliii.) states that it was the habit of Augustus, besides the exhibitions at the great spectacles, to show to the public any rarity that was brought over, "ut rhinocerotem apud septa; tigrim in scena; anguem quinquaginta cubitorum pro comitio:" and Dion remarks that the tigers (τίγρεις) first seen by the Romans, and as he thinks by the Greeks also, were those sent by the Indians as gifts when they were suing for peace from Augustus. The emperor Philip on one occasion exhibited ten tigers, together with thirty-two elephants, ten elks, sixty lions, thirty leopards, ten hyænas, one hippopotamus, one rhinoceros, forty wild horses, twenty wild asses, and numbers of deer, goats, antelopes, and other beasts; the brutal exhibition being crowned by the mortal combat of 2000 gladiators.

Gordian III. also exhibited ten tigers, and they were present in the shows of Antoninus and Elagabalus. Aurelian, in his triumph over Zenobia, showed four, together with a giraffe, an elk, and other rare animals.

Oppian cannot be mistaken when he writes ('Cyneg.,' iii. 130)—

> Παρδάλιες τε θοαί, καὶ τίγριες αἰολόνωτοι;

for here we have leopards and tigers in the same line, and the epithet αἰολόνωτος (having a variegated back) is quite applicable to the latter.

The Latin poets abound with allusions to the *Tigris*, that in most instances can hardly be allotted to any animal but the Royal Tiger; for though Virgil in his fourth 'Georgic' (l. 407), applies the epithet 'atra' (black) to 'tigris' in the passage where Cyrene is warning Aristæus as to the forms into which Proteus will transform himself, the word evidently does not there allude to colour, but to ferocity. In the fourth 'Æneid,' Dido, in her exclamation against Æneas, says—

> ——"Duris genuit te cautibus horrens
> Caucasus, *Hyrcanæque* admôrunt ubera *tigres*."

The tigers of Bacchus may be considered more doubtful. In the 'Gemmæ et Sculpturæ Antiquæ' there is a representation of a large female *Felis* with the thyrsus from a carnelian (corgnola), with the superscription, 'Tigre di Bacho;' but though the figure generally might pass for a Tiger, the tail of the animal is terminated by a shaggy tuft, and no tiger's tail is. Claudian comes much nearer to the mark where he describes Iacchus as marching crowned with ivy, and clad in the skin of the Parthian Tiger. When Virgil describes Orpheus, as 'mulcentem tigres' as 'soothing tigers' ('Georg.' iv., l. 510), and Horace, with nearly the same thought, addresses Mercury—

> "Tu potes tigres comitesque sylvas
> Ducere"

('Carm.,' iii., 'Ode,' ii.); and again, in his epistle to the Pisos ('De Arte Poeticâ,' l. 393), says of Orpheus—

> "Dictus ab hoc lenire tigres, rabidosque leones;"

they make the Tiger personify the greatest ferocity, and they certainly could not have chosen a more apt representative.

Martial speaks of the Tiger in the time of Titus and Domitian. ('Spect.,' Epig. 18, and lib. i., Epig. 105.)

To conclude this branch of the subject, we shall advert to one more literary proof, and one piece of pictorial evidence: and we think that no doubt can exist that, although the Royal Tiger was not so abundant in the Roman shows, particularly the earlier ones, as the leopard and the panther, its form and colouring, as distinguished from the other great cats, were as well and familiarly known to that people.

Pliny, in his chapter 'De Atlantis Arboribus et Cedrinis Mensis,' &c. ('Nat. Hist.,' xiii. 15), speaking of the grain or pattern of these tables, says that where it was oblong or lengthened, they were called tigrine, but where it was wreathed or curled (intorto), they were termed pantherine.

The pictorial evidence (so to speak) was furnished by the mosaic found at Rome near the arch of Gallienus. In this work of art, executed not improbably in commemoration of the exhibition of Claudius above noticed, four Royal Tigers, each devouring his prey, are well represented.

Our zoological societies and menageries have so increased in number during a long period of peace, that it becomes almost superfluous to describe a form so well known. But as a description of an animal holding so important a rank in the animal kingdom may be expected, we select that of Mr. Bennett, who remarks that the Tiger, closely allied to the Lion in size, in power, in external form, in internal structure, in zoological characters, in prowling habits, and in sanguinary propensities, is at once distinguished from it, and from every other of their common genus, by the peculiar markings of its coat. "On a ground which exhibits in different individuals various shades of yellow," says Mr. Bennett, "he is elegantly striped by a series of transverse black bands or bars, which occupy the sides of his head, neck, and body, and are continued upon his tail in the form of rings, the last of the series uniformly occupying the extremity of that organ, and giving it a black tip of greater or less extent. The under parts of his body and the inner sides of his legs are almost entirely white; he has no mane; and his whole frame, though less elevated than that of the lion, is of a slenderer and more graceful make. His head is also shorter and more rounded."

There is a paler variety, almost approaching to whitish, and with the stripes visible only in particular lights: this has been exhibited in this country. According to Du Halde, the Chinese Tiger (Lou-chu, or Lau-hu) varies in colour, some being white, striped with black and gray.

The size of the Tiger varies also; but the dimensions of the form, when fully developed, are, if we are to give credit to some accounts, the veracity of which has not been impugned, most formidable. Buffon notices an individual which was (tail included) 15 feet long; and it is on record that Hyder Ali presented to the Nabob of Arcot one which measured 18 feet in length. The average height varies from about four feet to about three feet, and the length from about eight or nine feet to six feet.

The Tiger is met with in Asia alone, and not in the south of Africa, as Buffon erroneously states; but authors generally agree that the Tiger is now rarely, if ever, met with on this side of the Indus. It is said to be found in the deserts which separate China from Siberia, and as far as the banks of the Oby; and in the south of China, and the larger East Indian Islands (Sumatra, for instance), it is common. Pennant states that it is found as far north as China and Chinese Tartary, and about Lake Aral and the Altaic Mountains. "It inhabits Mount Ararat," says the same author in continuation, "and Hyrcania, of old famous for its wild beasts; but the greatest numbers, the largest, and the most cruel, are met with in India and its islands. In Sumatra the natives are so infatuated that they seldom kill them, having a notion that they are animated by the souls of their ancestors. They are the scourge of the country; they lurk among the bushes on the sides of rivers, and almost depopulate many places. They are insidious, blood-thirsty, and malevolent, and seem to prefer preying on the human race." Hindustan may be considered the head-quarters of this destructive animal; there it is that he reigns unawed even by the lion, with which he disputes the mastery, and which is comparatively rare in that peninsula.

The bound with which the ambushed tiger throws himself upon his prey is as wonderful in its extent as it is terrible in its effects. Pennant justly observes that the distance which it clears in this deadly leap is scarcely credible. Man is a mere puppet in his gripe; and the Indian Buffalo is not only borne down by the ferocious beast, but carried off by his enormous strength. If he falls, it has been said that he makes off. This may be true in certain instances, but in general he does not slink away, but pursues the affrighted prey with a speedy activity which is seldom exerted in vain. This leads us to the observation of Pliny celebrating its swiftness, for which the Roman zoologist has been censured, most unjustly, apparently; nor is he the only author among the ancients who notices its speed. Oppian ('Cyneg.,' i. 323) speaks of the swift tigers as being the offspring (γενέθλη) of the zephyr. "Pliny," says Pennant, "has been frequently taken to task by the moderns for calling the tiger "animal tremendæ velocitatis;" they allow it great agility in its bounds, but deny it swiftness in pursuit. Two travellers of authority, both eye-witnesses, confirm what Pliny says: the one indeed only mentions in general vast fleetness; the other saw a trial between one and a swift horse, whose rider escaped merely by getting in time amidst a circle of armed men. The chase of this animal was a favourite diversion with the great Cam-Hi, the Chinese monarch, in whose company our countryman, Mr. Bell, that faithful traveller, and the Père Gerbillon, saw these proofs of the tiger's speed." Bell's 'Travels,' Du Halde.

In the "Ἑκατοντάς, seu Centuria Imaginum Hieroglyphicarum' (clo. loc. xxiii.) is a wood-cut (here copied) that may refer to such a scene.

Tiger pursuing a man on horseback.

Ferocious as the tiger is, and much as it may deserve the odium heaped upon it, the general chorus of the herd of authors who eulogise "the courage, greatness, clemency, and generosity" of the lion, contrasting it with the unprovoked ferocity, unnecessary cruelty, and poltroonery of the tiger, becomes ridiculous, though led by such names as Buffon and Pennant. The lion has owed a good deal to his mane and his noble and dignified aspect; but appearances are not always to be trusted. Mr. Barrow, with much more truth, characterises the king of beasts as powerful but treacherous. "Happy," says that traveller, "for the peasantry, the Hottentots, that those animals that are the objects of its destruction, were its noble and generous nature, that so oft has fired the imagination of poets, realised, and that his royal paw disdained to stain itself in the blood of any sleeping creature! The lion, in fact, is one of the most indolent of all the beasts of prey, and never gives himself the trouble of a pursuit unless hard pressed by hunger."

Pennant gives the following as an instance, after stating that there is a sort of cruelty in the devastations of the tiger unknown to the generous lion, as well as poltroonery in its sudden retreat on any disappointment: "I was informed by very good authority, that in the beginning of this century some gentlemen and ladies, being on a party of pleasure under the shade of trees, on the banks of a river in Bengal, observed a tiger preparing for its fatal spring; one of the ladies, with amazing presence of mind, laid hold of an umbrella and furled it full in the animal's face, which instantly retired, and gave the company an opportunity of removing from so terrible a neighbour."

This is a very pretty story, and the heroine deserves all praise, though it is not very clear what is meant by furling an umbrella, so as to make the alleged act square with the context, and the tiger was undoubtedly very polite. But tigers spring from a considerable distance, 15 or 20 feet, and from ambush; and we suspect that a cross-examination of the parties concerned might have slightly damaged the anecdote. Granting however that this bold lady walked up to a crouched tiger, and suddenly opened an umbrella in its face (for that, we presume, is the action meant), we may easily conceive that the surprise may have utterly confounded him; but this is not poltroonery. Indeed the same author immediately afterwards gives a tolerable proof of the animal's daring: "Another party had not, the same good fortune: a tiger darted among them while they were at dinner, seized on one gentleman, carried him off, and he never was more heard of."

But there is another story, a very sad one, which is pregnant with proof of the tiger's hardihood; we allude to the distressing death of Sir Hector Monro's son. Mr. Wood ('Zoography') relates the horrible occurrence in a few words:—

"This unfortunate gentleman," says Mr. Wood, "accompanied by three of his friends, went on shore, December 22, 1792, on Sawgar Island to shoot deer. They continued their sport till the afternoon, when they retired to the edge of a jungle to refresh themselves; where they had not remained long before one of the party, who was leaving the rest to shoot a deer, heard a dreadful roar, and saw a large tiger spring on poor Monro, and rush with him into the jungle with the greatest ease, dragging him through everything that obstructed his course, as if all were made to yield to his amazing strength. All that his companions could do to rescue their friend from this shocking situation was to fire at the tiger; and it is evident that their shots took place, since, in a few minutes after, Mr. Monro staggered up to them covered with blood, and fell. Every medical assistance that the ship afforded was procured for him immediately, but in vain; he expired in the course of twenty-four hours in the greatest agonies. His head was torn, his skull fractured, and his neck and shoulders covered with wounds made by the claws of the savage beast. It is worthy of observation, that neither the large fire that was blazing close to them, nor the noise and laughter which it seems they were making at the time, could divert this determined animal from his purpose." This story may be contrasted with the one related by Sparrman, and referred to above, of the lion retreating when boldly confronted, and certainly one animal cannot more than the other be charged with poltroonery.

But if any doubt as to the courage of the tiger be entertained, Father Tachard's account of a combat between that beast and two elephants at Siam will be sufficient proof. He relates that a lofty bamboo palisade was erected, occupying an area of about 100 feet square. Into this inclosure two elephants were introduced with their heads and trunks shielded by a kind of mask. A large tiger was now brought from its den, and held with cords till one of the elephants approached and inflicted two or three blows on its back with his trunk, so heavily laid on that it fell stunned, as if dead. Then they loosed the tiger. No sooner did he recover than he sprang with a dreadful roar at the elephant's trunk stretched ont in act to strike him; but the wary elephant drew up his trunk, and receiving the tiger on his tusks, hurled him into the air. This checked the fury of the tiger, as it well might, and he gave up the contest with the elephant; but he ran several times round the palisade, frequently springing at the spectators. Afterwards three elephants were set upon him, and they in turn dealt him such heavy blows that he again lay senseless, and would have been killed, if the combat, as it is most incorrectly called, had not been stopped. Nothing could be more unfair towards the tiger than the whole of this proceeding; and we will venture to say that no quadruped except a British bull-dog could have shown more 'pluck,' to use a common but expressive term, than this shamefully treated beast.

The older authors generally state that after the tiger has secured its prey it plunges its head into the body of the animal up to its very eyes, as if to satiate itself with blood till the corpse is exhausted, before it tears it to pieces. The best modern accounts tend to prove that the tiger is not more bloodthirsty and has no more blood-sucking propensities than the other great Cats; and that this blood-drinking habit is grossly exaggerated.

The tigress brings forth three or four, or four or five cubs at a time; and she is a very fond mother, braving every danger for them, and furiously attacking man and beast in their defence. The ancients knew this well. See Martial (lib. iii. Epig. 44):—

"Non tigris catulis citata raptis," &c.;

and Juvenal ('Sat.' vi.):—

"Tunc gravis illa viro, tunc orba tigride pejor:"

and though it is on record that a tigress in modern times devoured her cub, one should remember that this unnatural act was done in captivity, and that rabbits, sows, and cats, have done the same. But that in a state of nature the maternal feeling is very strong in the tigress, there can be no doubt. Captain Williamson, for example, relates that two tiger-cubs were brought to him when he was stationed in an Indian district. The country-people had found four in the absence of the tigress. The two brought to the captain were put in a stable, where they made a loud noise for several nights. The bereaved mother arrived at last, replying to their cries with fearful howlings, and the cubs were let loose under the apprehension that the infuriated tigress might break in. In the morning it was found that she had carried them away.

Various devices have been put in requisition to take or annihilate this destructive quadruped, and we shall mention one or two of them before we advert to the chase of the animal upon a grander scale. Ten rupees were formerly offered by the East India Company for every tiger destroyed within the provinces where their power and influence extended: a small reward, but sufficient, conjointly with the depredations of the animal, to stimulate the poorer classes to destroy it.

A kind of spring-bow was formerly laid in its way, and discharged a poisoned arrow, generally with fatal effect, when the animal came in contact with a cord stretched across its path; and this method is said to be still in use in some places. Again, a heavy beam was suspended over the way traversed by the tiger, which fell and crushed him on his disengaging a cord which let the beam fall. A Persian device is said to consist of a large spherical strong interwoven bamboo cage, or one made of other suitable materials, with intervals throughout three or four inches broad. Under this shelter, which is picketed to the ground in the tiger's haunt, a man provided with two or three short strong spears takes post by night, with a dog or a goat as his companion, wraps himself in his quilt and goes to sleep. A tiger arrives, of whose presence the man is warned by the dog or the goat, and generally after smelling about, rears himself up against the cage, upon which the man stabs him resolutely with his short spear through the interstice of the wicker-work. It seems ludicrous to talk of taking a tiger with bird-lime: but it is said to be so captured in Oude. When a tiger's track is ascertained, the peasants, we are told, collect a quantity of leaves resembling those of the sycamore, and common in most Indian underwoods; these they smear with a kind of bird-lime, which is made from the berries of an indigenous and by no means scarce tree, and strew them with the adhesive substance uppermost in some gloomy spot to which the tiger resorts in the heat of the day. If he treads on one of the limed leaves he generally begins by trying to shake it from his paw, and not succeeding proceeds to rub it against his jaw in order to get rid of it. Thus his eyes and ears become agglutinated, and the uneasy animal rolls, perhaps among many more of the smeared leaves, till he becomes enveloped: in this state he has been compared to a man who has been tarred and feathered. The tiger's irritation and uneasiness find vent in dreadful howlings, on which the peasants hasten to the spot, and shoot him without difficulty.

The plan of the box-trap and looking-glass, a device to be found in ancient sculpture, according to Montfaucon, is said to be practised among the Chinese at the present day.

So much for the trapping of the tiger. The tiger-hunt is perhaps the grandest and most exciting of wild sports. Upon such occasions the whole neighbourhood is on the move, and two hundred elephants have been known to take the field. From ten to thirty of these gigantic animals, each carrying sportsmen armed with rifles, have not unfrequently started for the jungle.

Captain Mundy gives a short but spirited description of a tiger-hunt. The party, he tells us, found immense quantities of game, wild hogs, hog-deer, and the neilghie: they however strictly abstained from firing, reserving their whole battery for the nobler game of which they were in pursuit. They had to pass through a thick forest, and the author gives a very interesting description of the power and dexterity of the elephants in overthrowing trees to make a road:—"On clearing the wood," says he, "we entered an open space of marshy grass not three feet high; a large herd of cattle were feeding there, and the herdsman was sitting singing under a bush, when, just as the former began to move before us, up sprang the very tiger to whom our visit was intended, and cantered off across a bare plain dotted with small patches of bush-jungle. He took to the open country in a style which would have more become a fox than a tiger, who is expected by his pursuers to fight and not to run, and as he was flushed on the flank of the line only one bullet was fired at him ere he cleared the thick grass. He was unhurt; and we pursued him at full speed. Twice he threw us out by stopping short in small strips of jungle, and then heading back after we had passed; and he had given us a very fast trot of about two miles when Colonel Arnold, who led the field, at last reached him by a capital shot, his elephant being in full career. As soon as he felt himself wounded the tiger crept into a close thicket of trees and bushes, and crouched. The two leading sportsmen overran the spot where he lay, and as I came up I saw him through an aperture rising to attempt a charge. My mahout had just before, in the heat of the chase, dropped his ankors, or goad, which I had refused to allow him to recover, and the elephant being notoriously savage, and further irritated by the goading he had undergone, became consequently unmanageable; he appeared to see the tiger as soon as myself, and I had only time to fire one shot when he suddenly rushed with the greatest fury into the thicket, and falling upon his knees nailed the tiger with his tusks to the ground. Such was the violence of the shock that my servant, who sat behind, was thrown out, and one of my guns went overboard. The struggles of my elephant to crush his still resisting foe, who had fixed one paw on his eye, were so energetic that I was obliged to hold on with all my strength to keep myself in the houdah. The second barrel too of the gun, which I still retained in my hand, went off in the scuffle, the ball passing close to the mahout's ear, whose situation, poor fellow, was anything but enviable. As soon as my elephant was prevailed upon to leave the killing part of the business to the sportsmen they gave the roughly-used tiger the coup-de-grace. It was a very fine female, with the most beautiful skin I ever saw."

In the 'Asiatic Annual Register' for 1804, a gentleman who had been present at the killing of above thirty tigers gives an account of a hunting-party of the Nawab Asuf-ud-Dowlah. After describing the immense cavalcade of the nawab he says:—"The first tiger we saw and killed was in the mountains. We went to attack him about noon; he was in a narrow valley, which the nawab surrounded with above two hundred elephants; we heard him growl horribly in a thick bush in the middle of the valley. Being accustomed to the sport, and very eager, I pushed in my elephant; the fierce beast charged me immediately; the elephant, a timid animal, turned tail and deprived me of the opportunity to fire. I ventured again, attended by two or three other elephants; the tiger made a spring, and nearly reached the back of one of the elephants on which were three or four men; the elephant shook himself so forcibly as to throw these men off his back, and they tumbled into the bush; I gave them up for lost, but was agreeably surprised to see them creep out unhurt. His Excellency was all this time on a rising ground near the thicket looking on calmly, and beckoning to me to drive the tiger towards him. I made another attempt, and with more success; he darted out towards me on my approach, roaring furiously and lashing his sides with his tail. I luckily got a shot and hit him; he retreated into the bush, and ten or twelve elephants just then pushed into the thicket, alarmed the tiger, and obliged him to run towards the nawab, who instantly gave him a warm reception, and with the assistance of some of his omras, or lords, laid the tiger sprawling on his side. A loud shout of 'wha! wha!' proclaimed the victory."

There is in Bishop Heber's 'Journal' a most graphic description of a tiger-hunt, but our limits will not permit us to indulge in more of these stirring accounts.

Those who have represented the tiger as untameable have no ground for the assertion. It is as capable of being tamed, and of attachment, even to fonduess, for its keeper as any other animal of its kind. We have seen many instances of this mutual good understanding between the man and the beast, and Mr. Bennett mentions a remarkable example in his 'Tower Menagerie.' A tigress of great beauty, in the Tower when he wrote, and scarcely a year old, had been during her passage from Calcutta allowed to range about the vessel unrestricted, and had become perfectly familiar with the sailors, showing not the slightest symptoms of ferocity. On her arrival in the Thames the irritation produced by the sight of strangers instantly changed her temper, rendering her irascible and dangerous. So sulky and savage was she that Mr. Cops, who then kept the lions in the Tower, could hardly be prevailed on by her former keeper, who came to see her, to allow him to enter her den; but as soon as the tigress recognised her old friend she fawned on him, licked him, caressed him, and manifested the most extravagant signs of pleasure; and when at last he left her, she cried and whined for the remainder of the day. The tame tigers of the mendicant priests, or fakirs, of Hindustan are well known.

But whilst there can be no doubt of the tameable qualities of the tiger, and indeed of all the great Cats, they are not to be incautiously trusted. The natural disposition is always ready to break out; and the mildest of them, though

——"Ne'er so tame, so cherish'd, and lock'd up,
Will have a wild trick of his ancestors."

Thus Bontius states that in 1628 a tiger at Batavia, which had been brought up from a cub, and accustomed to men all its life, escaped from its cage, fastened on a horse which was feeding near, and killed it; so that the citizens rose upon the tiger with fire-arms, and slew it in its turn to prevent further mischief.

Royal Tiger (*Felis Tigris*).

We conclude this part of our sketch with the account given by John Mason, who formerly kept the beasts in Exeter 'Change, to Mr. Wood, of his fearful encounter with one of these captives.

About the year 1802 a tiger had been purchased by Mr. Alpey to send to the Emperor of Germany, and placed in the Tower, there to remain for a few days till the ship destined to convey the animal abroad was ready. The beast was confined in a large sufficiently-ventilated wooden case, lined with iron hoops, some of which he ripped off during the first night of his confinement, and gnawed the case partly through. This being perceived, the next day the case was repaired by the addition only of a strong piece of wood nailed on the outside. "The consequence," says Mr. Wood, "might well be expected. The tiger renewed his efforts, and in the course of the following night made his escape, and sprung upon a wall ten feet high, where he remained till Mason came in the morning. The fear of losing such a valuable animal induced this poor fellow, for a reward of ten guineas, to hazard his life in an attempt to secure the tiger. For this purpose he engaged a sergeant and some other persons to assist him, whom he placed in a room, the door of which opened upon the leads, from whence he could reach the animal. He then provided himself with a strong rope, one end of which he gave through the window to his companions, and with the other, having a running noose upon it, he slowly approached the tiger, and threw it over its neck. This was the critical moment: the people within were directed to pull the rope and secure the beast. Unfortunately the noose slipped off, and the enraged animal immediately sprung upon the keeper, fixing his teeth into the fleshy part of his arm, and tearing his breast and hand in a dreadful manner with his claws. In this shocking situation the poor man lay under the tiger; while the sergeant cut a bullet into four parts, and, having loaded his musket, he fired through the window at the animal, who the moment he received the shot quitted his hold, and after staggering for a few minutes expired. The bullet however which destroyed the tiger had nearly been equally fatal to the man, one of the quarters having glanced against his temple, and deprived him of all sense and motion for a considerable time. Nevertheless, after keeping his bed a fortnight, he gradually recovered, and is now (1807) perfectly well, though he will carry the marks of his enemy about with him as long as he lives." ('Zoography,' vol. i.)

In the East the Tiger is associated emblematically with power. Thus the Chinese mandarins covered their seats of justice with its skin. In plate 17 of the atlas to Sir George Staunton's 'Embassy to China,' representing a military post, two swordsmen are habited and shielded so as to exhibit a tigerine aspect. The tiger-soldiers of Hyder Ali and Tippoo Saib were amongst the choicest of their troops. The tiger's head, gorgeous with jewels, that formed the principal ornament of the throne of Hyder and Tippoo, and was taken by the British among the spoils of the latter at Seringapatam, is well known; as is the automatic representation, clumsy enough it must be admitted, of a royal tiger tearing to pieces a soldier in the pay of the British, and imitating the growling of the beast and the cries of the man, taken also upon the same occasion. (See the Museum at the India House.)

Tiger-Cats.—We now proceed to speak of those species of *Felis* which, on account of their resemblance to the tiger, are called after that animal Tiger-Cats.

Asiatic Tiger-Cats.

Felis Nepalensis, Horsfield and Vigors. Size of the *Felis Javanensis*, Horsf., but its habit more slender, the tail and neck proportionally elongate. Ground-colour gray, with a very slight admixture of tawny; bands and spots of the head, back, neck, throat, abdomen, and thighs, deep black; superior longitudinal bands resembling those of *F. Javanensis*. Ground-colour of throat and abdomen nearly white; the lower flanks marked with a faint tawny longitudinal streak. Cheeks streaked with two parallel longitudinal lines, at the termination of which follows a transverse lunar mark which passes with a bold curve to the angle of the mouth, near which a very narrow band crosses the throat. Sides of the neck appearing marked with two broad waving bands, at the termination of which stands an oblong regularly transverse band. Neck underneath nearly immaculate. Shoulder and flanks exhibiting irregular diversified marks, the anterior oblong, the posterior angular, of a mixed tawny and black, and, individually, above or posteriorly with a broad dash of saturated black: they are scattered over the sides without any regular longitudinal disposition, but they have generally an oblique direction. Abdomen marked throughout with uniform oval spots; anterior thighs within exhibiting one broad black band, the posterior thighs two. Rump and thighs marked externally with roundish or oblong spots; tail above, to within about an inch of the tip, with uniform roundish spots, arranged posteriorly in regular transverse bands. Head above and ears agreeing generally with those of *F. Javanensis*. Length from extremity of nose to root of tail, 1 foot 10½ inches. Length of tail, 10½ inches. (Vigors and Horsfield.)

Nepaul Tiger-Cat (*Felis Nepalensis*).

Dr. Horsfield and Mr. Vigors observe that the distinguishing characters of this species are its comparatively lengthened habit; the slenderness and proportional length of the tail; the disposition of the marks on the flanks, and the character of these marks as far as regards their diversified form; and the saturated black patch with which they are individually marked at their upper or posterior edge.

"In the Bengal Cat," say those zoologists, "these marks have a different disposition; they are oblong, and arranged on the flanks in regular succession longitudinally. The materials contained in the museum at the India House have enabled us to make this statement, which is founded on the examination of a specimen brought by General Hardwicke, and on a careful drawing prepared under the eyes of Dr. Hamilton. We have thus two distinct species of small cats from India, and the elucidation of this point is of some importance, as it appears from the following remark in M. Temminck's monographs, 'l'existence de cette espèce dans l'Inde n'est pas constatée,' that he entertained some doubts on the existence of the Bengal Cat. It is not our intention, at present, to give a comparative analysis of all the species which resemble our animal. The discrimination of many species of *Felis* is at all times a difficult subject; and on many of them naturalists still disagree. Our immediate object is to indicate a new form of *Felis* from the upper provinces of India, differiug essentially from that which is found in the plains of Bengal; and so direct the attention of naturalists in that country to a more careful investigation of the various oriental species of this interesting genus."

The same authors state that a specimen was presented hy Captain Farrer, of the East India Company's service, to the Zoological Society of London. It came immediately from Calcutta, where it was said to have been sent from Nepaul. It lived some time in the Society's Garden, but was extremely wild and savage. It generally remained in a sitting posture, like that of the common domestic cat, and never paced its den in the manner of most other animals of the group. ('Zool. Journ.,' vol. iv.)

African Tiger-Cats.

Felis Serval, the Serval. Upper parts clear yellowish, with hlack spots; lower parts white, with black spots also, hut they are less numerous. Upon the head and neck the markings are most conspicuous, and form symmetrical lines on each side directed towards the shoulders. On the other parts of the body they are placed irregularly. On the hack they are lengthened, and show a disposition to form four rows; on the body and thighs they are larger and round, and they are smaller hut equally round on the extremities. Upon the face and muzzle they are minute. Back of the ears hlack at the base, succeeded by a transverse white har; tips of the ground-colonr of the body. On the inside of the fore limbs two conspicuous black transverse bars; the hind limbs with similar markings, hut less defined; last joints of the limbs of a paler tint than the rest of the body, the spots on them round and very small. Tail with eight black rings; tip of the same colour. Length, exclusive of tail, 1 foot 11½ inches; tail 9 inches. Height, when standing erect, about 12 inches at the shoulder, and 15 inches at the hind quarters. (F. Cuvier.)

Serval (*Felis Serval*).

The animal from which the above description was taken was a very yonng male. Its temper was mild and gentle, and its disposition sportive. It played like a domestic cat, or rather kitten, chasing its tail, and amusing itself with anything that it could roll with its paw.

The Serval is a native of Southern Africa. There are generally some living specimens in our menageries. It has been exhihited in that of the Zoological Society of London.

American Tiger-Cats.

It is in America that the Tiger-Cats are most numerons and beautiful, and there their manners have been hest noticed hy competent observers. We select three examples of the varieties of form and colouring exhihited hy this group in that quarter of the globe.

Felis pardalis (Linn.), the Ocelot. This, the most beautiful perhaps of all the Tiger-Cats, almost defies description. Mr. E. Bennett has however given a very faithful acconnt from two living specimens, one existing, when he wrote, in the Tower of London, and the other in the Garden of the Zoological Society in the Regent's Park. His description is as follows:—

"Body when full grown nearly three feet in length; tail rather more than one foot; medium height about 18 inches. Ground-colour of fur gray, mingled with a slight tinge of fawn, elegantly marked with numerous longitudinal hands, the dorsal one continuous and entirely black, the lateral (six or seven on each side) consisting for the most part of a series of elongated spots with hlack margins, sometimes completely distinct, sometimes running together. The centre of each spot of a deeper fawn than the ground-colour external to them; this deeper tinge is also conspicuous on the head and neck, and on the outside of the limbs, all of which parts are irregularly marked with full black lines and spots of various sizes. From the top of the head between the ears, there pass hackwards, towards the shoulders, two or more freqnently four uninterrupted diverging bands, which are full black anteriorly, but generally hifurcate posteriorly, and inclose a narrow fawn-colour space with a black margin; between these there is a single longitudiual, somewhat interrupted, narrow black line, occupying the centre of the neck above. Ears short and rounded, externally margined with black, surrounding a large central whitish spot. Under parts of the body whitish, spotted with black, and the tail, which is of the same ground-colour with the body, also covered with black spots." (Bennett, 'Tower Menagerie.')

Ocelot (*Felis pardalis*).

Mr. Bennett remarks that he has, in the above description, stated the length of the tail at more than a foot; and that in all the known Ocelots, as well as in all the species (of which there are several) that approach it in form and colouring, the proportionate length of the tail is at least equal to that which he has given as its average measurement. The tail however of the Tower specimen did not exceed six or seven inches; its extremity was overgrown with hair, and there was no cicatrix. Still, its equality throughout and its abrupt stumpiness induced the helief that this ahbreviation was purely accidental; and he felt hy no means inclined to regard that specimen as a new species, to be distinguished hy the excessive shortness of that appendage, by the unusually pale colour of its markings, and by some slight peculiarity in the mode of their arrangement, which, he observes, varies in every individual that he had seen.

This animal is a native of Mexico, Paraguay, and prohahly Peru.

The Ocelot remains in the deep forests during the day, sallying forth at night in quest of smsll quadrupeds and birds, the latter of which it successfully chases in the trees, for it is a very expert climher. If it he, as is generally supposed, the Tlacoozelotl, Tlalocelotl, *Catus Pardus Mexicanus* of Hernandez, it is said to stretch itself out as if dead on the limb of some tree when it spies monkeys in the neighhourhood. They, urged by curiosity, proceed to examine the supposed defunct, and fall victims to their curiosity.

The Ocelot has been so completely tamed as to he left at liberty, and it is said to be capable of strong attachment to its master. Mr. Bennett states that the specimen in the Tower, a male, was perfectly good-tempered, exceedingly fond of play, and had much of the character and manners of the domestic cat. Its food consisted principally of rabbits and birds; the latter it plucked with great dexterity, and always commenced its meal with the head, of which it seemed particularly fond; hut it did not eat with the ravenous avidity which characterises nearly all the animals of this tribe.

Felis mitis (F. Cuvier), the Chati; Chibiguazu of D'Azara (?); *Felis Chibiguazu* (Desm.). Ahout a third larger than the domestic cat: length, exclusive of tail, rather more than two feet; tail, 11 inches; height to middle of back, about 1 foot 2 inches. Ground-colour of fur on the upper parts, pale yellowish; on the lower, pure white; at the roots, dull gray, and very thick and close. Body covered with irregular dark patches; those upon the back entirely black, and disposed longitudinally in four rows; those upon the sides surrounded with hlack, with the centres of a clear fawn, arranged in nearly five rows. Spots upon the lower part of the body, where the ground-colour of the fur is white, full, and arranged in two lines composed of six or seven patches on each side. Limbs covered with nearly round spots of smaller dimensions: on the fore legs, near the body, two transverse hands. On the throat a sort of half-collar, and on the under jaw two crescent-shaped spots. Behind each eye two bands about two inches long, terminating opposite the ear. Forehead bordered hy two lines, between which are numerous spots, and, at their origin, a hlackish mark from which the whiskers spring. Outside of the ear hlack, with a white spot upon the small lobe. Base of the tail spotted with small hlotches, which towards the end run into half-rings, which are hroadest on the upper surface. Pupil round. (F. Cuvier.)

This animal, a female, was extremely gentle; and if those with whom it was familiar passed its cage or did not approach it, it would express its discontent hy a short cry. It manifested great delight when it was caressed. It lived in the Paris menagerie, and was procured from a dealer in Brest. The Chati is a native of South America.

Desmarest and others identify this animal with the Chibiguazu of D'Azara. Temminck, who received a skin from Rio de Janeiro, considers it distinct.

Chati (*Felis mitis*).

D'Azara's description comes very near to that above given, as far as colouring is concerned; but he gives the average length as 3 feet 6 inches: the individual which he described, the largest male he had seen, was 4 feet all but an inch in length; tail, 13 inches; height at shoulders, 1 foot 6 inches, and behind 1 foot 7½ inches. It was so fat, that immediately after death it weighed 35 lbs.: the females, he says, are rather less.

The same acute observer, speaking of his Chibiguazu, remarks that some of the Guaranese call the domestic cat Chibi, and others Mbracayá. In the same manner, he says, some give the wild animal of which he is treating the name of Chibi-Guazu, and others that of Mbracayá-Guazu; both appellations signifying Great Cat. Many Spaniards, he adds, call it Onza (Ounce).

He states that the species is so common that his friend Noseda captured eighteen individuals in two years, within two leagues of his village; but he adds that, notwithstanding this abundance, few are acquainted with it, the huntsman and dogs never falling in with it, and being unable to penetrate its haunts: he very much doubts whether any quadruped hides itself more effectually. He describes it as remaining by day in the most impenetrable places, and as coming forth after dusk, especially on dark stormy nights, when the chibiguazus daringly enter the corrals and court-yards, though no instance is known of their detection by the dogs. When the moon shines they abstain from visiting inhabited spots, and never are trapped: to lie in wait for them with a gun is hopeless, so sharp a look-out do they keep. They carry off domestic fowls from trees which they climb, sometimes six in one night, and often leave several dead. Men and dogs are avoided by them with extreme caution, and each pair is supposed to live in a separate district, for a male and female, and no more, are always caught in the same place. Noseda formed a trap of strong stakes, with three divisions: in the middle he placed a white fowl, so that it might not only be heard but seen at a distance: the other divisions were so framed as to shut by the falling of the planks as soon as the chibiguazus entered. This trap was set in the places to which they resorted for prey, and those caught were turned into a great den in Noseda's court-yard. Some of these got away, and were taken again two or three times in the same trap; they were recognised by ear-marks and other proofs. D'Azara infers from this that the idea of danger was obliterated from their recollection by their desire to possess the fowl. He remarked that all which were kept in the den deposited their excrements in their drinking-place, and when he substituted a narrow-necked jug to prevent this, they mounted to its edge for that purpose, and never missed the vessel or its immediate neighbourhood. Nearly the whole day was spent by them rolled up in a ball, and when a chibiguazu wished to stretch himself, he first licked the one at his side. When straw was put into their den, or so that they could reach it by thrusting their paws through the bars, it was always found that on the day following they had placed it in a heap, after having divided it into bits some quarter of an inch long, and on this they reposed. The small sticks and twigs with which the inside of their den was furnished were broken and torn to pieces in like manner. Twilight and night were passed in pacing to and fro close to the sides of their den; and if crossed or interrupted by another, they fuffed and gesticulated like an angry cat, but without using their paws. They never quarrelled, unless they were very much irritated, and then they struck at each other with their fore paws. They devoured five pounds of flesh per day when first caught, but afterwards three sufficed. A portion was prepared for each of the twelve or fourteen individuals confined, and they took it with their paws according to the length of time they had been there, without any interference on the part of the others. If however the animal whose turn it was did not take his portion, or disregarded it, another immediately snatched at it without any defence on the part of the right owner except by sneezing, and sometimes by blows with its fore paws. A walk was made for them, inclosed by a sort of hurdle, so that rats, fowls, ducks, or young dogs could be introduced into it: upon opening the cage it was observed that usually one only went out for each victim, and almost always according to the order of their confinement. Cats and dogs they seized with their mouth by the nape of the neck, overlaid them, and then kept them so that they could not stir, till they were dead. Cats' flesh appeared to produce the mange, fretting the chibiguazus, making them mew like cats, and at last destroying them. Snakes, vipers, and toads were also eaten by them, but this diet occasioned violent and continued vomiting; they wasted to skeletons, and died in a few days. If the dog introduced equalled them in size, they touched him not, for it appears that they do not assist each other. If a chibiguazu cannot master any prey alone, he leaves it. Birds were caught by the head and neck, and thoroughly stripped of their feathers before they were eaten. No unnecessary cruelty was manifested. Noseda observed that one did not kill a fowl put into his den till the third day. D'Azara and his friend frequently closed the doors of the yard, and opened the den that the chibiguazus might leave it: those lately caught went first; and sometimes the old ones would not go out even when their den was entered that it might be swept. They were left at liberty for several hours, during which they examined every crevice, and then lay down to sleep. When boys persecuted them with sticks, they retreated to their den without turning on their persecutors, even when severely beaten. A male on one occasion becoming very lazy, on entering his den he was abused and bitten by his female, as if to punish him. Some individuals were incarcerated for more than a year without exhibiting any sign of love. In the night their eyes shone like those of a domestic cat, and they resembled that animal in their form and habits, in lying down, licking and cleaning themselves, washing their faces with their paws, fuffing, sneezing—in fact, in every way. D'Azara concludes by stating that his friend caught a young one, and it became so thoroughly tame that it slept in the skirts of his clerical gown, and went about loose. He affirmed that no animal could be more tractable: but it devoured the poultry of his neighbours, and they killed it.

Felis Pajeros, the Pampas-Cat, Pajero, or Jungle-Cat. Fur of great length; longer hairs of the back upwards of 3 inches, and those of the hinder part of the back from 4½ to 4¾ inches in length. General colour pale yellow-gray; numerous irregular yellow or sometimes brown stripes running obliquely from the back along the sides of the body. On each side of the face two stripes of yellowish or cinnamon commencing near the eye, and extending backwards and downwards over the cheeks, on the hinder part of which they join, and form a single line, which encircles the lower part of the throat. Tip of the muzzle and chin white; a spot in front of the eye, and a line beneath the eye, of the same colour; belly, inner side and hinder part of fore legs, white also. An irregular black line running across the lower part of the chest, and extending over the base of the fore legs externally; above this line two other transverse dark markings more or less defined on the chest. On the fore legs three broad black bands, two of which encircle the leg; on the posterior legs about five black bands externally, and some irregular dark spots internally. Feet yellowish, and under side of tarsus of a slightly deeper hue. On the belly numerous large irregular black spots. Ears moderate, with long white hairs internally; externally of the same colour as the head, except at the apex, where the hairs are black, and form a slight tuft. Tail short somewhat

Pampas-Cat (*Felis Pajeros*). 'Zool. of the Beagle.'

bushy, and devoid of dark rings or spots—the hairs are in fact coloured as those on the back. On the upper part of the body each hair brown at the base, then yellow, and at the apex black. On the hinder part of the back the hairs almost black at the base, and, on the sides of the body, each hair gray at the base; there is then a considerable space of yellowish-white colour: towards the apex they are white, and at the apex black. The greater number of the hairs of the moustaches white. Length from nose to root of tail 26 inches; of tail (fur included), 11 inches. Height of body at shoulders, 13 inches. Size about equal to that of the common wild-cat of Europe; but the Pampas-Cat is stouter, its head smaller, and its tail shorter. (Waterhouse.)

Mr. Waterhouse ('Zoology of the Beagle') observes that the markings of this animal vary slightly in intensity: those on the body, he remarks, are generally indistinct; but the black rings on the legs are always very conspicuous.

D'Azara says that he knows not, nor has he heard, that this species exists in Paraguay, although it formerly may have been seen there; but as the country became tolerably well peopled, and there were fewer plains, the inhabitants probably extirpated it. He caught four in the Pampas of Buenos Ayres, between 35° and 36° S. lat., and three others on the Rio Negro. He says they are found on both sides of the La Plata.

Darwin ('Zoology of the Beagle') gives as its habitat Santa Cruz, Patagonia, and Bahia Bianca. He states that it is common over the whole of the great plains which compose the eastern side of the southern part of America; and he says he has reason to believe, from the accounts he received, that it is found near the Strait of Magellan, which would give it a range of nearly 1400 miles in a north and south direction, D'Azara having stated that it extends northward as far as 30° S. lat. One of Mr. Darwin's specimens was obtained in 50° S. lat., at Santa Cruz.

D'Azara says that the natives call this animal Gato Pajero, because it lives on the plains, concealing itself in jungles, without entering into the woods and thickets. Guinea-Pigs (*Aperea*), according to him, form its principal food. Mr. Darwin states that it takes its name from 'paja,' the Spanish word for straw, from its habit of frequenting reeds. The specimen taken by him at Santa Cruz was met with in a valley where thickets were growing. When disturbed it did not run away, but drew itself up and hissed.

III. Leopards.

The larger Spotted Cats are known by this name. They are found in both the Old and New Worlds.

The form seems to have its most perfect development in the ancient continent and the islands of the Old World, though it must be admitted that the American Jaguar, in point of size, strength, and sturdiness of make, excels the Leopards of Asia and Africa.

Felis Pardus (the Panther) of Linnæus first claims our notice. It has been a question whether the Leopard and Panther are distinct species, or only varieties. Linnæus, in his last edition of the 'Systema Naturæ,' included under the specific name of *Felis Pardus* the *Panthera*, *Pardalis*, *Pardus*, and *Leopardus* of Gesner; *Pardus* mas., *Panthera* femina of Alpin (Egypt); *Pardalis* of Ray; *Tigris Mexicana* of Hernandez; and *Pinuum Dasypus*, Nieremb., 'Nat.' Under the specific name of *Onca* he includes *Pardus*, seu *Lynx Brasiliensis* of Ray, and the *Jaguara* of Maregrave. He has no species named *Leopardus*; but Gmelin has, and in his edition we find the following species:—1. *F. pardus*—*F.* cauda elongata, corpore maculis superioribus orbiculatis; inferioribus virgatis—(the description of Linnæus) Schreb., 'Säugethiere,' iii. p. 384, t. xcix., with the following references and synonyms:—*Felis* ex albo flavicans, maculis nigris in dorso orbiculatis, in ventre longis, Briss. 'Quadr.'; the names of Gesner and Ray as quoted above; *Pardus* maculis seu scutulis variis, Ludolf, Æthiop.; Panthère of Buffon. 2. *F. Unica*, Once, Buffon. 3. *F. Leopardus*—*F.* cauda mediocri, corpore fusco maculis subcoadunatis nigris. Erxl., 'Syst. Mamm.,' p. 509. n. 5; Schreb., 'Säugeth.,' iii. p. 387, t. ci.; *Uncia*, Caj., 'Op.,' p. 42, Gesn., 'Quadr.,' p. 825; Leopard of Buffon. 4. *F. Onça*, the Jaguar.

Cuvier separates the Panther from the Leopard specifically. The Panther, La Panthère, he makes the *Felis Pardus* of Linnæus, and the *Pardalis*, ἡ Πάρδαλις of the ancients. He describes the Panther as yellow above, white beneath, with six or seven rows of black spots in the form of roses, that is to say, formed by an assemblage of five or six small simple spots on each side; the tail of the length of the body not reckoning the head. This species he speaks of as being spread throughout Africa and in the warm countries of Asia, as well as in the Indian Archipelago; and he states that he has seen individuals where the ground-colour of the fur is black, with spots of a still deeper black (*Felis melas*, Pér.), but that they do not form a species, observing that both yellow and black cubs have been seen sucking the same mother (1829). Pennant ('Hist. Quadr.,' 1793) figures a Black Leopard, and describes the variety as follows:—"In the Tower of London is a black variety, brought from Bengal by Warren Hastings, Esq. The colour universally is a dusky black, sprinkled over with spots of a glossy black, disposed in the same forms as those of the Leopard. On turning aside the hair, beneath appears a tinge of the natural colour."

Felis Leopardus (the Leopard) of Linnæus, as he quotes it (but it is not mentioned by Linnæus in his last edition of the 'Syst. Nat.;' it appears, as we have seen, in Gmelin's edition), Cuvier assigns to Africa, remarking that it is similar to the Panther, but with ten rows of smaller spots. These two species, he adds, are smaller than the Jaguar; and he says that there is a third, a little lower on the legs, with the tail equalling the body and head in length, and with more numerous and smaller spots (*Felis chalybeata*, Herm. Schreb., 101).

Cuvier does not notice the Panther, ὁ Πάνθηρ of Aristotle ('Hist. Anim.,' vi. 35), and indeed this animal is supposed by many not to have been one of the Leopard kind. In a note to *Felis chalybeata* Cuvier states that it is to that species M. Temminck applies the name of Panther; but the former adds it is certain that the Panther so well known to the ancients, and which appeared so often in the Roman shows and games, could not be an animal from the recesses ('fond') of Eastern Asia.

Cuvier does not insert in the text of his 'Règne Animal' the Ounce of Buffon; but in a note to the second edition he speaks of it as differing from the Panthers and the Leopards by more unequal spots, more irregularly scattered, partly notched or ringed, &c., and as appearing to be found in Persia; adding that his knowledge of it is only derived from Buffon's figure, and from that which Mr. Hamilton Smith has inserted in the English translation of the 'Règne Animal' from an individual which had been seen living in London.

The Panther and the Leopard were once regarded by M. Temminck as varieties of the same species, *F. Leopardus*, but he has separated them specifically in his 'Monograph.'

Colonel Smith's Ounce was detected by him in the Tower when that fortress included a menagerie among its attractions. The animal is said to have been brought from the Gulf of Persia, but we only learn that it was very distinct from all other species in make, markings, and general appearance.

The same author describes the Panther of the ancients as standing higher than the Jaguar, and as approaching in its form, which is slender, to that of the Hunting Leopard (*F. jubata*), though much larger in proportion.

M. Lesson enumerates the following Leopards as belonging to the old continent:—

F. Panthère, *F. Pardus*, Linn., Temm., 'Monog.' Less than the Leopard; tail as long as the body and head. Locality, Bengal; and probably does not exist in Africa.

F. Leopard, *F. Leopardus*, Linn. (Gmel.), Temm.; *F. Pardus*, Cuv.; Faahd of the Arabs. Rather less than a lioness. Tail (22 vertebræ) of the length of the body. Locality, Africa and India.

F. jubata, the Cheetah, or Hunting Leopard. Locality, Southern Asia.

Among those *Felidæ* which are distributed in the Polynesian group of islands (Iles Asiatiques de la Polynesie) M. Lesson notices—

F. melas, Péron, observing that this animal, which M. Temminck believed to be a variety of the Leopard, constitutes, on the contrary, a species entirely confined to Java, and especially in the most isolated eastern districts, such as Blambangan (Brambanan?). The size of the animal he states to be that of the Panther; its fur of a deep black, on which are traced zones of the same colour, but less lustrous. This leopard, which is called Arimaou by the Javanese, is used for the singular combats of the 'Rampok,' for the details of which M. Lesson refers to the 'Zool. de la Coquille,' t. i. p. 139. He adds that he saw a beautiful specimen belonging to the resident of Sourabaya, and he was assured that *F. melas* was not rare in the island. He also refers to *F. macrocelis*, Horsfield. Localities, Sumatra and Borneo. (1827.)

Mr. Bennett ('Gardens and Menagerie of the Zoological Society,' 1830) says, "Whether the Leopard and the Panther are in reality distinct species, and if so on what particular characters the specific distinction depends, are questions that have been so variously solved by writers of the highest eminence that we cannot, without better opportunities for comparison of specimens than we at present possess, adopt the conclusions to which any one of them has come upon the subject. Linnæus, not perceiving any sufficient grounds of distinction, referred both names to one and the same animal; Buffon added a third, that of the Ounce, and increased the confusion by describing as the Panther of the ancients and an animal of the old continent the Jaguar, which is now known to be peculiar to the new continent; Cuvier subsequently founded a distinction upon the greater or smaller number of rows of spots disposed along the sides of the body; and Temminck, rejecting these characters as unimportant, has lately fixed upon the comparative length of the tail as affording the only sure means of discrimination. In this uncertainty the question remains for the present; but there can be no doubt of the complete distinction between both the animals involved in it and that which we have figured, the mistaken Panther of Buffon, the Jaguar of Brazil, and *Felis Onça* of systematic writers. It may not however be useless to observe, that of the figures given by Buffon as Panthers and Jaguars that which is entitled the male Panther is in all probability a Leopard; the female is unquestionably a Jaguar; the Jaguars of the original work, and of the supplement, are either Ocelots or Chatis; and that which purports to be the Jaguar or Leopard, although probably intended for a Cheetah, is not clearly referrible by its form and markings to any known species."

Mr. Swainson, in his 'Classification of Quadrupeds' (1835), leaves the question untouched. In his 'Animals in Menageries' (1838) he gives the following species:—

The Leopard; Leopard, Cuvier; *F. Leopardus*, H. Smith, in Griff., Cuvier.

The Panther, *F. Pardus*, Linn., Hamilton Smith; Panthère, Cuvier. Panther of the Ancients, *F. Pardus Antiquorum*, Hamilton Smith, in Synopsis of Griff., Cuv.

Under the title 'Leopard' Mr. Swainson says, "Although the names of Leopard and Panther have been long familiar in common language, and have conveyed the idea of two distinct species, yet it is perfectly clear that no scientific writer of the last generation either described, or indeed appeared to know, in what respects the animals differed. It seems that numerous specimens of what is called the Leopard are in the Zoological Gardens, and one has been figured in the book so entitled; but Mr. Bennett has not made the slightest attempt to investigate the subject, or to throw any light upon this difficult question. In this dilemma we shall therefore repose on the opinions of Major Hamilton Smith, whose long experience and accuracy of observation are well known, and whose authority in this department of nature deservedly ranks above that of any other naturalist of this country. The Leopard, as defined by Major Smith, when compared with the Jaguar and the Panther of naturalists, is uniformly of a paler yellowish colour, rather smaller, and the dots rose-formed, or consisting of several dots partially united into a circular figure in somé instances, and into a quadrangular, triangular, or other less determinate forms in others: there are also several single isolated black spots, which more especially occur on the outside of the limbs. The Panther, according to Professor Lichtenstein of Berlin, 'resembles the Jaguar in having the same number of rows of spots, but is distinguished by having no full spots on the dorsal line.' But, as Major Smith observes, it does not appear that full spots on the dorsal line always make a specific character of the Jaguar; and the Asiatic Leopard is sometimes distinguished by this peculiarity, though it does not in other respects resemble the American animal. When therefore it is said that the Panther much resembles the Jaguar, it is always to be strongly suspected that the type whence the observations have been taken is in reality an American animal." Mr. Swainson then, after copying Major Smith's scientific description of the Leopard, proceeds to say, "Our own opinion of the specific dissimilarity between the Leopard and the Panther, judging from what has been written on the subject, is in perfect unison with that of Major Smith; while the following remark of that observing naturalist, incidentally inserted in his account of the Panther of antiquity, seems to us almost conclusive:—'The open spots which mark all the Panthers have the inner surface of the annuli or rings more fulvous (in other words darker) than the general colour of the sides; but in the Leopard no such distinction appears, nor is there room, as the small and more congregated dots are too close to admit it.' In truth, if there is any reliance to be placed in the most accurate figures hitherto published, the small spots of the leopard and the large ones of the Panther must strike even a casual observer, and lead him to believe that the two animals were called by different names."

Leopard (*Felis Leopardus*). Senegal.

In the 'Gemmæ et Sculpturæ Antiquæ' of Gronovius there is an engraving of a boy driving a car drawn by two Panthers, rather high on their legs, from a carnelian, headed 'Carro di Bacho;' but Gronovius thinks that though this 'reda' may be attributed to Bacchus, it may nevertheless be taken for a representation of one from the Circensian games, for which opinion he gives his reasons. Captain Smyth, R.N., in his interesting 'Descriptive Catalogue of a Cabinet of Roman Imperial Large Brass Medals,' notices a medal of Commodus, on the reverse of which the emperor on horseback galloping across the field, with a chlamys floating behind him, is in the act of casting a dart at a Panther, which is 'showing fight.' He also refers to the figure of a Lynx or Panther on the reverse of one of Septimius Severus, and to that of a Panther (among other animals) on the smaller coins of Gallienus.

With regard to the *F. Pardus Antiquorum* of Smith, Mr. Swainson remarks that the species, if such it really be, is supposed to be the animal known to ancient writers by the name of *Panthera*. It is however, he adds, now so rare, or has been so little distinguished, that Major Smith is only acquainted with one example, which is in the museum of the elector of Hesse Cassel, in whose menagerie it had probably lived. Nothing was known of its native country or of its manners. (See H. Smith's description, including characters intermediate between the Jaguar of America and the Panthers and Leopards of the Old World.)

Mr. Swainson also notices the Ounce in the same work, referring to Major Smith's description, and regretting that that able zoologist had not entered into further particulars. Mr. Swainson states that, judging from the figure engraved from Mr. Smith's drawing, he should term it a lower and more thick-set animal than the Panther; the spots larger, more irregular, and much fewer, but differing more especially in having the tail decidedly annulated with black rings, while those of all the Panthers are spotted. The body, he adds, is described as whitish; while yellow or fawn-colour is the universal tint both of the Panthers and Leopards.

In June, 1837, Dr. Gray brought before the notice of a meeting of the Zoological Society of London some *Mammalia* which he had lately purchased for the British Museum from a collection made by the late Colonel Cobb in India, among which was an adult specimen of the Once of Buffon ('Hist. Nat.'), on which Schreber formed his *F. Uncia*, which has been regarded by Cuvier, Temminck, and most succeeding authors as a Leopard, but which, continued Dr. Gray, "is as a distinct species, easily known by the thickness of its fur, the paleness of its colour, the irregular form of the spots, and especially by the great length and thickness of the tail." Dr. Gray observed that a more detailed description of this animal was unnecessary, as it agreed in all particulars with the young specimen described by Buffon.

Ounce (*Felis Uncia*). From the specimen in the British Museum.

Of the manners of the true Leopards in a state of nature not much seems to be known. They are very active, climb well, and take their prey by surprise. In captivity they are playful, but apt to be treacherous. Mrs. Bowdich won the heart of a Leopard by kindness, and by presenting him with lavender-water in a card-tray, taught him to keep his claws sheathed. The luxurious animal revelled in the delicious essence almost to ecstacy; but he never was suffered to have it if he put forth his claws. We regret that our limits will not allow us to give this lady's graphic account of her amiable favourite 'Sai,' which the reader will find in Loudon's 'Magazine.'

Among the larger Spotted Cats of the Old World we must notice the Rimau-Dahan, *F. macrocelis*, Temm., Horsfield; *F. nebulosa* (?), H. Smith, Griffith.

This species partakes in some measure of the markings of both the Tiger and Leopards, though it seems to be more nearly allied to the latter than to the former.

Probable size when full grown about 4 feet from the nose to the root of the tail, which may be reckoned at 3 feet 6 inches; height at shoulder about 1 foot 10 inches. Colour whitish-gray, with an inclination to ashy or brownish-gray, no yellow or red tint. Stripes and spots dark, oblong, irregular, and broad on the shoulders, interrupted and angular on the sides, posterior edges of the broad spots and stripes marked by a line of deep velvet black; limbs stout, feet and toes robust; tail very long, large, and lanuginous.

It inhabits Sumatra. M. Temminck thinks it is also found on the continent of India, having received mantles belonging to the Diakkers made of the skin of this species.

The specimen brought to England alive by Sir Thomas Stamford Raffles was taken when very young in the forests of Bencoolen, and died during the process of dentition soon after its arrival. Dr. Horsfield gives the following dimensions: sex, femalo :—

	Ft.	In.
Length of the body and head, from the extremity of the nose to the root of the tail	3	0
Length of the tail	2	8
Height at the shoulders	1	4
Height at the rump	1	3
Circumference of the abdomen	2	0
Circumference of the neck	1	2

Sir Stamford Raffles gives the following account of the manners of the species from personal observation made on two individuals :—"Both specimens, while in a state of confinement, were remarkable for good temper and playfulness; no domestic kitten could be more so; they were always courting intercourse with persons passing by, and in the expression of their countenance, which was always open and smiling, showed the greatest delight when noticed, throwing themselves on their backs, and delighting in being tickled and rubbed. On board the ship there was a small Musi Dog, who used to play round the cage and with the animal, and it was amusing to observe the playfulness and tenderness with which the latter came in contact with his inferior-sized companion. When fed with a fowl that died, he seized the prey, and after sucking the blood and tearing it a little, he amused himself for hours in throwing it about and jumping after it in the manner that a cat plays with a mouse before it is quite dead. He never seemed to look on man or children as prey, but as companions; and the natives assert that when wild, they live principally on poultry, birds, and the smaller kinds of deer. They are not found in numbers, and may be considered rather a rare animal, even in the southern part of Sumatra. Both specimens were procured from the interior of Bencoolen, on the banks of the Bencoolen River. They are generally found in the vicinity of villages, and are not dreaded by the natives, except as far as they may destroy the poultry. The natives assert that they sleep and often lay wait for their prey on trees; and from this circumstance they derive the name of Dahan, which signifies the fork formed by the branch of a tree, across which they are said to rest and occasionally stretch themselves. Both specimens constantly amused themselves in frequently jumping and clinging to the top of their cage, and throwing a somerset, or twisting themselves round in the manner of a squirrel when confined, the tail being extended and showing to great advantage when so expanded." ('Zool. Journ.,' vol. i.)

Rimau-Dahan (*Felis macrocelis*).

Dr. Horsfield, in the work above quoted, confirms the account of Sir Stamford from his own observation on the individual that was lodged on its arrival in Exeter 'Change. The Doctor, who does not appear to acquiesce in the identity of *F. nebulosa* with the Rimau-Dahan, gives in the same paper a most elaborate and accurate description of the latter, to which we must refer our readers. He also gives a figure (pl. xxi.) from a drawing made by the late William Daniell, Esq., R.A., a few days after the animal had been placed in Exeter 'Change.

We now come to a very interesting form, one of those gradations by which Nature appears to pass from one type to another. The *Felis jubata* of Schreber, Chetah, Cheetah, or Hunting Leopard, exhibits both in its external form and habits such a mixture of the Feline and Canine tribes as to justify apparently the appropriate name *Cynailurus*, employed by M. Wagler to designate it as a genus. Thus, as Mr. Bennett observes ('Tower Menagerie'), the Hunting Leopard, uniting to the system of dentition, the general habit, and many of the most striking peculiarities of the cats, some of the distinguishing features, and much of the intelligence, the teachableness, and the fidelity of the dog, becomes a sort of connecting link between two groups of animals otherwise completely separated, and exhibiting scarcely any other character in common than the carnivorous propensities by which both are in a greater or less degree actuated and inspired. "Intermediate," continues Mr. Bennett, "in size and shape between the leopard and the hound, he is slenderer in his body, more elevated on his legs, and less flattened on the fore part of his head than the former, while he is deficient in the peculiarly graceful and lengthened form, both of head and body, which characterises the latter. His tail is entirely that of a cat; and his limbs, although more elongated than in any other species of that group, seem to be better fitted for strong muscular exertion than for active and long-continued speed." From these and other indications Mr. Bennett is of opinion that the animal approaches much more nearly to the cats than the dogs, and continues it among the former. The anatomy of the Cheetah, as subsequently demonstrated by Professor Owen at a meeting of the Zoological Society of London, shows indeed that, in internal structure, this leopard is undoubtedly feline: of its habits we shall hereafter have occasion to speak. In the paper last above alluded to, 'On the Anatomy of the Cheetah, *Felis jubata*, Schreb.,' Professor Owen commenced by remarking on *Felis* as a truly natural genus, and by observing that the anatomical structure of the animals composing it offers even fewer differences than their outward forms. The principal deviation from the common type was stated to be that which obtains in the organs of voice of the Lion (and, as Mr. Martin has observed, in those of the Jaguar also), where the larynx is situated at a considerable distance from the posterior margin of the bony palate, the soft palate and the tongue being proportionally increased in length, thus forming a gradually expanded passage, which leads from the glottis, where the air is rendered so sonorous, to the mouth. This structure, Professor Owen remarks, may contribute in the Lion to produce the peculiar roar of that animal.

Cheetah (*Felis jubata*; *Cynailurus jubatus*, Wagl.).

In the Cats generally, it was stated, the connection of the os hyoides to the cranium is not by a long elastic ligament, as in the Lion, but by an uninterrupted series of bones. This latter structure exists in the Cheetah. The Cheetah has also the circular pupil of the Lion, Tiger, Leopard, and Jaguar, and is perhaps the most diurnal of the genus. In the form of the œsophagus, and in the transverse rugæ of its lower half, the Cheetah was stated to agree with the Lion; and, as in it and in the other species of *Felis*, the œsophagus was not prolonged into the abdomen, but terminated immediately after passing through the diaphragm in the stomach. This organ, according to Professor Owen, has in the Cheetah all the peculiarities which are found in the genus *Felis*. The intestines also agree in character with those of that group; and the cæcum, as usual in it, is simple, having none of the convolution which is found in the Dog. The liver, pancreas, and spleen resembled those of the Cats generally; as did also the kidneys in the arborescent form of their superficial veins—a form however equally common, Professor Owen remarks, to the *Viverridæ* and the *Felidæ*, which also agree in having spiculæ on the tongue. The viscera of the thorax in the Cheetah agreed with those of the Cats. The lytta, or rudiment of the lingual bone, so conspicuous in the Dog, is reduced in it, as in the other feline animals, to a small vestige. There was no bone of the penis, and the glans had retroverted papillæ. The elastic ligaments of the ungual phalanges existed in the same number and position as those of the Lion; they were however longer and more slender, their length alone occasioning the incomplete retraction of the claws as compared with the rest of the *Felidæ*. Professor Owen concluded by observing that in the circulating, respiratory, digestive, and generative systems, the Cheetah conformed to the typical structure of the genus *Felis*. ('Zool. Proc.,' 1833.)

Mr. Bennett gives the following description of the Cheetah:—Ground-colour bright yellowish fawn above; nearly pure white beneath; covered above and on the sides by innumerable closely approximating spots, from half an inch to an inch in diameter, which are intensely black, and do not, as in the leopard and others of the spotted cats, form roses with a lighter centre, but are full and complete. These spots, which are wanting on the chest and under part of the body, are larger on the back than on the head, sides, and limbs, where they are more closely set: they are also spread along the tail, forming on the greater part of its extent interrupted rings, which however become continuous as they approach its extremity, the three or four last rings surrounding it completely. The tip of the tail is white, as is also the whole of its under surface, with the exception of the rings just mentioned; it is equally covered with long hair throughout its entire length, which is more than half that of the body. The outside of the ears, which are short and rounded, is marked by a broad black spot at the base, the tip, as also the inside, being whitish. The upper part of the head is of a deeper tinge; and there is a strongly marked flexuous black line, of about half an inch in breadth, extending from the inner angle of the eye to the angle of the mouth. The extremity of the nose is black, like that of a dog. The mane not very remarkable; consisting of a series of longer, crisper, and more upright hairs which extend along the back of the neck and the anterior portion of the spine. Fur with little of the sleekness which characterises that of the cats, but exhibiting on the contrary a peculiar crispness not to be found in any other of the tribe. ('Tower Menagerie.')

According to Mr. Bennett the Cheetah is found in Asia and Africa. He says, "Chardin, Bernier, Tavernier, and others of the older travellers, had related that in several parts of Asia it was customary to make use of a large spotted cat in the pursuit of game, and that this animal was called Youze in Persia and Chetah in India; but the statements of these writers were so imperfect, and the descriptions given by them so incomplete, that it was next to impossible to recognise the particular species intended. We now however know with certainty that the animal thus employed is the *Felis jubata* of naturalists, which inhabits the greater part both of Asia and Africa. It is common in India and Sumatra, as well as in Persia, and is well known both in Senegal and at the Cape of Good Hope; but the ingenuity of the savage natives of the latter countries has not, so far as we know, been exerted in rendering its services available in the chase in the manner so successfully practised by the more refined and civilised inhabitants of Persia and Hindustan."

Mr. Swainson states ('Classification of Quadrupeds,' 1835) that the Hunting Leopards appear to be of two species—one inhabiting Africa, the other India; and that it deserves attention that one of these possesses a sort of mane, of which the other is said to be destitute. The mane however, in specimens from both localities, seems to be much the same. The animal figured by Pennant as the Hunting Leopard was brought from India by Lord Pigot. Three others, captured at Seringapatam among the effects of Tippoo, were presented by Lord Harris to George III., who placed them in the Tower. The couple from which Mr. Bennett made his accurate description came from Senegal. The Cheetah was indeed, as the last-mentioned zoologist remarks, very imperfectly known in Europe till of late years. Linnæus does not appear to have been acquainted with it, and Buffon's Guêpard was described from the skin only. Guêpard is the name by which the skin of the animal was known commercially in reference to the Senegal market; and Mr. Bennett is of opinion that Buffon described it without suspecting its identity with the Asiatic animal, "the trained habits of which, misled probably by the authority of Tavernier, he erroneously attributed to his imaginary Ounce. Subsequent French zoologists had rectified this error, and it was generally believed that the tamed leopard of Bernier, the Youze, the Guêpard, and Tavernier's Ounce, were one and the same animal; but it was not until a year or two ago"—Mr. Bennett wrote the passage quoted in 1829—"that the possession of a living specimen, brought from Senegal, in the menagerie of the Jardin du Roi, enabled M. F. Cuvier to ascertain its characters with precision. The comparison of this African specimen with the skins sent from India, and with the notes and drawings made in that country by M. Duvaucel, at once puts an end to all doubts of the identity of the two animals."

In 1831 Colonel Sykes observed that *Felis jubata*, Linn., and *Felis venatica*, H. Smith (Cheeta of the Mahrattas), appear to be identical, the specific differences deduced from the hair originating in domestication. A skin of the wild animal, according to the colonel, has a rough coat in which the mane is marked, while domesticated animals from the same part of the country are destitute of mane, and have a smooth coat. ('Zool. Proc.')

In the East, where these beautiful animals are employed in the chase, they are carried to the field in low cars whereon they are chained. Each leopard is hooded. When the hunters come within view of a herd of antelopes the leopard is unchained, his hood is removed, and the game is pointed out to him; for he is directed in the pursuit by his sight. Then he steals along cautiously and crouchingly, taking advantage of every means of masking his attack, till he has approached the herd unseen, within killing distance, when he suddenly launches himself upon his quarry with five or six vigorous and rapid bounds, strangles it instantaneously, and drinks its blood. The huntsman now approaches the leopard, caresses him, wins him from his prey by placing the blood which he collects in a wooden ladle under the nose of the animal, or by throwing to him pieces of meat; and whilst he is thus kept quiet hoods him, leads him back to his car, and there chains him. If the leopard fails in consequence of the herd having taken timely alarm he attempts no pursuit, but returns to his car with a dejected and mortified air.

The skin is an article of some importance in the trade of Senegal, but appears to be neglected at the Cape of Good Hope, where the animal is called Luipard by the Dutch colonists; indeed it seems to be of rare occurrence there, for Professor Lichtenstein notices one of the skins as being worn by a Kaffir chief as a badge of distinction.

Of the habits of the Hunting Leopard, in a state of nature, not much is known; but it may be surmised that it captures its prey much in the same way as it does when employed in the chase. Mr. Bennett gives a very pretty picture of the manners of the two that furnished his description, and as it would be spoiled by abridgment we here insert it:—"They are truly," writes Mr. Bennett, "an elegant and graceful pair, having, when led out into the courtyard in their couples, very much of the air and manners of a brace of grayhounds. When noticed or fondled they purr like a cat, and this is their usual mode of expressing pleasure. If, on the other hand, they are uneasy, whether that uneasiness arises from cold, from a craving after food, from a jealous apprehension of being neglected, or from any other cause, their note consists of a short uniform and repeated mew. They are extremely fond of play, and their manner of playing very much resembles that of a cat; with this difference however, that it never, as in the latter animal, degenerates into malicious cunning or wanton mischief. Their character indeed seems to be entirely free from that sly and suspicious feeling of mistrust which is so strikingly visible in the manners and actions of all the cats, and which renders them so little susceptible of real or lasting attachment. The Cheetahs, on the contrary, speedily become fond of those who are kind to them, and exhibit their fondness in an open, frank, confiding manner. There can, in fact, be little doubt that they might with the greatest facility be reduced to a state of perfect domestication, and rendered nearly as familiar and faithful as the dog himself." ('Tower Menagerie,' London, 8vo., 1829.)

Most of the Hunting Leopards brought to England died in no long time after their arrival, and the French seem to have had no better success. The Zoological Society of London succeeded in keeping their specimens very well: the principal food given was lean mutton.

Felis Onça (Linnæus), the Jaguar, or American Panther, is the form of the Leopard found in the New World. It is the Onza of Marcgrave and the Panther or Great Panther of the furriers.

In form the Jaguar is robust, far stouter than the Leopard, and is very strongly, not to say clumsily, built. The body is thicker, the limbs shorter and fuller, and the tail scarcely reaches the ground when the animal is well up on its feet. The head is larger and rather shorter than that of the Leopard, and the profile of the forehead more prominent. When full grown the animal is said to measure from 4 to 5 feet from the nose to the root of the tail. "These differences of form," says Mr. Bennett ('Gardens and Menagerie of the Zoological Society'), "are accompanied by differences in colour and markings equally decisive. The general appearance is at the first glance the same in both; but the open roses of the Leopard are scarcely more than half the size of those of the Jaguar, and they all inclose a space of one uniform colour, in which, unless in some rare and accidental instances, no central spots exist; while in the latter animal most of those which are arranged along the upper surface, near the middle line of the back, are distinguished by one or two small black spots inclosed within their circuit. The middle line itself is occupied in the Leopard by open roses intermixed with a few black spots of small size and roundish form; that of the Jaguar, on the contrary, is marked by one or two regular longitudinal lines of broad, elongated, deep black patches, sometimes extending several inches in length, and occasionally forming an almost continuous band from between the shoulders to the tail. The black rings towards the tip of the latter are also more completely circular than in the Leopard."

But the skin of the Jaguar is subject to much variation, and Sir William Jardine ('Naturalists' Library,' 'Mammalia,' vol ii.) gives three figures from different sources illustrating strongly marked differences in the spots.

It is a native of South America—Paraguay and the Brazils principally—but it is said to have been found from the southern extremity to the Isthmus of Darien.

Mr. Martin, in his anatomical description of a Jaguar that died in the Gardens at the Regent's Park ('Zool. Proc.,' 1832), notices the immense volume of the chest as contrasted with that of the abdominal cavity, a circumstance which might, he thinks, be considered as furnishing an index to the habits and vital energy of this tribe of active and ferocious quadrupeds. That the Jaguar is an animal of great power and frequently of a daring dispositiou there can be no doubt; but the balance of the evidence is against its equalling, if not exceeding, the royal tiger of the east in ferocity. Of its power D'Azara gives the following anecdote. A Jaguar had struck down a horse; and D'Azara gave instructions that the latter should be drawn within musket-shot of a tree wherein he intended to pass the night, in expectation that the Jaguar would returu for his prey. While D'Azara was gone to prepare himself, the Jaguar returned from the opposite side of a river broad aud deep, seized the horse in its mouth, drew it to the water some 60 paces, swam across the river with it, landed it, and drew it into a wood hard by. All this was witnessed by the person whom D'Azara had placed in concealmeut to watch till his return.

Jaguar (*Felis Onça*).

The Jaguar is a most expert climber. Sonnini saw the scratches left by the claws of one on the smooth bark of a tree some 40 feet high without branches. He traced the marks of several slips made by the climber, but the animal had at last reached the top. Humboldt heard the Jaguar's yell from the tops of the trees followed by the sharp shrill long whistle of the terrified monkeys, as they seemed to flee. None of the living quadrumanes or quadrupeds seem to come amiss to it, and birds and fish, which last it is said to take in shallows, are sacrificed to its voracious appetite. The Jaguars will openly seize cattle, horses, and sheep from the enclosures; and the havoc made by them is great, as will be easily imagined when we learn from Humboldt that their numbers are such that 4000 were killed annually in the Spanish colonies, aud 2000 were exported every year from Buenos Ayres only. Nor are the reptiles free from its attacks. The shells of turtles were pointed out to Humboldt as having been emptied of their contents by the Jaguar, which, it seems, watches them as they come to the sandy beeches to lay their eggs, rushes ou them, and turns them on their backs. He then insinuates his paw between the shells, and scoops out the contents as clean as if a surgeon's knife had been employed. As the beast turns many more than he can devour at one meal, the Indians often profit by his dextrous cunning. He will, it is stated, pursue this persecuted race into tho water where it is not very deep, and will dig up and devour the eggs.

With all this the Jaguar does not seem to be very dangerous to man, when boldly confronted, though D'Azara records frequent instances of his attackiug the lord of the creation. The Jaguar will indeed often follow travellers, according to Sonnini and Humboldt, but the latter celebrated naturalist and observer only heard of one instance where a Llanero was fouud torn in his hammock, and that happened opposite tho Island of Achaguas. He relates, on the other hand, a story of two Indian children, a girl and a boy, the one about seven, and the other niue years old, who were at play ou the outskirts of a village, about two o'clock in the afternoon, when a large Jaguar came out of the woods bounding towards them playfully, his head down and his back arched, like a cat. He approached the boy, who was not sensible of his danger, and began to play with him, till at last the Jaguar struck him so hard on the head with his paw as to draw blood, whereupon the little girl struck him smartly with a small switch, and he was bounding back not at all irritated, when the Indians, alarmed by the cries of the girl, came up.

When Mr. Waterton ('Wanderings') was encamped on the banks of the Essequibo, he was visited by one of these prowlers. "Whenever the fire got low the Jaguar came a little uearer; and when the Indian renewed it, he retired abruptly; sometimes he would come within twenty yards, and then we had a view of him, sitting on his hind legs like a dog; sometimes he moved slowly to aud fro; aud at other times we could hear him mend his pace, as if impatient. At last the Indian, not relishiug the idea of having such company, set up a most tremendous yell. The Jaguar bouuded off like a race-horse, and returued uo more. It appeared by the print of his feet next morning, that he was a full grown one."

The Jaguar is said to make its attacks on quadrupeds by springing upon the neck of his prey; then placing one of his paws upon the back of its head, while he turns round the muzzle with the other, he dislocates the neck and deprives it of life.

He, in his turu, falls a victim to man. The Spaniards aud Indians hunt him in various ways. Sometimes he is driven by dogs 'to tree,' in which case he is despatched with the musket or lance; sometimes the pack force him amoug the bushes, and then is exhibited, sometimes a daring feat. A single Indiau, with his left arm euveloped in a sheep-skin, and with a 5-feet lance in his right, goes boldly in to him. The hunter parries the onset of the furious beast with his shielded arm, and at the same time deals him such a thrust with his lance as seldom requires repetition. The lasso is also used with the best effect upon the plains.

There is a black variety of the Jaguar, Le Jaguar Noir of the French, *Felis nigra* of Erxleben, aud probably the Jaguarete of Marcgrave.

This seems to have been the animal noticed by Lieutenat Maw R.N., ('Journal of a Passage from the Pacific to tho Atlautic,' 8vo., Loudon, 1829), at Para, as a 'black onça, or tiger.' It had been procured up the rivers by Mr. Campbell, and, when Mr. Maw saw it, was a formidable animal. "I am not sure," says that gentleman, "that it had the length of limb of a Bengal Tiger, but it was thicker, and, I think, it would have weighed more. When lying dowu, there appeared to be scarcely any leg, but its thigh was like an immense ham." Lieutenant Maw relates some amusing anecdotes about this animal, for which we refer the reader to his interesting book.

IV. The Lynxes.

The name of Lynxes is applied by zoologists to a subdivision of the great genus *Felis*, or Cats, well marked externally, and elevated by Dr. Gray to the rank of a genus, under the appellation of *Lyncus*.

There doos not appear to be any considerable difference between the organisatiou of the Lynxes and that of the other Cats; but it is extremely probable that there is some modification about the boues of the tongue, and the organ of the voice generally, to produce the peculiarly powerful noise aualogous to what is called 'spitting' and 'swearing' in the domestic cat.

Linnæus, in his last edition of the 'Systema Naturæ,' records but one species, *F. Lynx*, to which he assigns the woods and deserts of Europe and Canada as localities. This was probably the European Lynx, aud the descriptions may have been founded on Lyuxes from Canada as well as Europe.

Gmelin, in his edition, adds three other species, *F. Chaus*, *F. Caracal*, and *F. rufa*; and gives two varieties of *F. Lynx*, with Europe, America, Northern Asia, and eveu Japan, as the habitations.

Pennaut notices seveu species of Lynxes—the Mountain Lynx, Cat-a-Mouutain of Ray (North America), the Serval, the Lynx, the Bay Lynx, the Caspiau Lynx, the Persian Lynx, and the Libyau Lynx. He states that the third inhabits the vast forests of the north of Europe, Asia, and America; "not India, though poets havo harnessed them to the chariot of Bacchus, in his conquest of that country." The fourth, he says, is an iuhabitant of the inuer parts of the province (now the state) of New York. To the fifth he assigns the "reeds and woods in the marshy parts that border on the western sides of the Caspian Sea, particularly about the Castle Kislar, on the river Terek," and the Persian provinces of Ghilan aud Mazanderan; adding that it is frequeut about tho mouth of tho Kur, the ancient Cyrus. Persia, India, and Barbary are the countries which he states to be the localities of the sixth; aud Libya and Barbary are mentioned by him as the couutries of the seventh. It is doubtful what animals Pennant meant to designate under some of these names. The Serval is uot considered to be a Lynx.

Cuvier observes that thero aro known iu commerce, under the name of Loups Cerviers (*Lupus cervarius*), four or five sorts of Lynxes, which had long been confouuded by naturalists, and whose specific limits were not perhaps well fixed when he wrote. We shall proceed to notice the arrangement of M. Temminck, and theu return to observo what part of it is adopted by Cuvier.

M. Temminck gives the following as species:—

1. *F. cervaria;* described as nearly equalliug a wolf in size, and possibly the Kattlo of Linnæus and tho Swedes; but it has been remarked that no skius of it are contaiued in the cargoes that arrive from the Baltic. In commerce the skins of *F. cervaria* are said to be only obtained from the markets of Moscow, to which they are brought from the provinces of Asia. It is considered as probable that this species may have been confounded, under tho name of the Canadiau Lynx, with—

2. *F. borealis*, which is intermediate in size betweeu the fox and

the wolf. This comprehends the Canadian but not the Mississippi Lynx of Cuvier, and is said to inhabit the north of both the old and the new continents: its fur, less valuable than that of *F. cervaria*, is stated to be received equally from Sweden and from Hudson's Bay.

3. *F. Lynx* (true Lynx), different from, but nearly allied to *F. cervaria*, *F. borealis*, *F. rufa*, and—

4. *F. pardina*. Size of a badger, but the legs longer, resembling *F. rufa* in form and size; tail short, but longer in proportion than that of *F. Lynx*. *F. pardina* is the Loup-Cervier of Perrault, and is found only in the south of Europe, the centre being the locality of the true Lynx. On this species Colonel Sykes makes the following statement:—"Although Temminck, in his 'Monographie de Mammalogie,' p. 116, in a note, says the skins of this European *Felis* is well-known amongst the furriers as the Lynx of Portugal, I have nowhere been able to meet with a specimen in London; and as amongst my friends scarcely any one appeared to be aware of the existence of a Spanish Lynx, I thought it might be acceptable to the members to exhibit specimens in a state of maturity and nonage. In Andalusia, whence the specimens come, it is called Gato Clavo (clavo meaning the pupil of the eye), illustrative of the spotted character of the skin. Some peasants in Andalusia make short jackets of the skins. The animal inhabits the Sierra Morena. I bought both skins at Seville for thirty reales, about 6*s*. 3*d*. Neither the British Museum nor the Zoological Society has specimens.

"Temminck describes the *Pardina* as 'Toutes les parties du corps lustre, a peu près de la même teinte que dans le caracal.' This is certainly not the description of my animal, the colour of the adult being reddish-grey, and that of the non-adult light fawn; nevertheless there are so many other points common to both, that it would be unadvisable to consider them distinct." ('Zool. Proc.,' 1838.)

5. *F. Caracal*, Nubian Caracal, and Cat of the Desert of Bruce; Persian Cat (Lynx) of Pennant.

6. *F. aurata*. Rather less than the Caracal. Country unknown. Skin purchased from a London dealer.

7. *F. Chaus* (Güldenstedt), figured by Schreber. The other animals described under this name are considered to be referrible to—

8. *F. caligata*, Booted Lynx of Bruce; *F. Libycus* (Olivier); Libyan Caracal of Buffon.

Of these Baron Cuvier notices *F. cervaria* as the finest and largest; *F. borealis*; *F. Lynx* (which has almost entirely disappeared from populous countries, but is still to be found in the Pyrenees, the mountains of the kingdom of Naples, and even it is said in Africa); *F. pardina*, Oken, from the south of Europe; *F. rufa*, Gülden.; and *F. Chaus*, or Lynx of the Marshes of Caucasus, Persia, and Egypt. Cuvier further observes that it is believed at present that the Booted Lynx, *F. caligata*, Temm., may be distinguished from *F. Chaus*; but he remarks that *F. caligata* is at least very nearly approximated to it, and that it has the same habits.

F. Caracal (Persia, Turkey, &c.), which he considers to be the true Lynx of the ancients, closes Cuvier's list of species; but he alludes in a note to *Lynx fasciatus*, *L. Floridanus*, and *L. montanus* of Rafinesque; and to *F. aurata* of Temminck, as belonging to this tribe.

Dr. J. E. Gray places his genus *Lyncus* (sub-family *Felina*) between the genera *Felis*, Linn., and *Prionodon*, Horsfield.

M. Lesson gives the following species:—1. *F. Lynx*, the Loup-Cervier of the furriers, Goupe of the Norwegians, and Wargelue of the Swedes, who recognise three very different varieties of it. He states that the whole of Europe is its habitat, where it has become very rare, and he says that they point out a pale variety *F. rufa*, Pennant (?), and that 'Le capitaine Brooks en indique trois,' which may be, in his (the captain's) opinion, regarded as species. 2. *F. pardina*, Oken, Temm.; Loup-Cervier of the French Academicians; to this Portugal, Sardinia, Sicily, and Turkey are assigned as localities. Next follows *F. Serval*, which cannot be considered a Lynx. 3. *F. cervaria*, Temm. 4. *F. borealis* (Chat du Canada, Geoff.), to which the northern countries of America and Asia are given as its distribution. 5. *F. Caracal*, the Lynx of the ancients (Africa, Persia, and Arabia). M. Lesson describes the differences of the Caracals of Algiers, of Nubia, and of Bengal. 6. *F. Chrysothrix* and *F. aurata*, Temm.; country unknown. 7. *F. Chaus*, Gülden. (Egypt, Nubia, and Caucasus). 8. Booted-Lynx (*F. caligata*, Bruce, Temm.; *F. Libycus*, Oliv.). To this a range is given from Egypt to the Cape of Good Hope in Africa, and the south of Asia. M. Lesson also notices as specifically different the *F. Manul* of Pallas and Desmarest, a species not admitted by Temminck, but which has, according to Pallas, the appearance of the Lynx. ('Mongolian Tartary.')

Sir William Jardine ('Naturalists' Library,' 'Mammalia,' vol. ii. 1834), who adopts the genus *Lyncus* or *Lynchus* of Dr. Gray, as the fifth genus of the *Felinæ*, enumerates the following species: *Lynchus Caracal*; *L. aurata*; *L. Chelidogaster*, inhabits Chili (Temm., Mus. Leyd.); *L. caligata*, Bruce; *L. nigripes*, Burchell, inhabits South Africa; *L. Chaus* (Gülden., Rüpp.); *L. Canadensis*; *L. rufa*, Bay Lynx, inhabits banks of Colombia River, United States, not Canada (Temm.); *L. fasciata*, Banded Lynx (Richardson), inhabits North America, woody countries in the neighbourhood of the Pacific (Lewis and Clark); and *L. Lynx*.

Sir William Jardine remarks that there is yet considerable confusion among the Lynxes of America, and that, except the Canada Lynx, the species are perhaps not well determined. He observes that Mr. Vigors and Dr. Horsfield describe one under the title of *F. maculata* from Mexico.

Sir William further states that another Asiatic Lynx may be perhaps added in the *Felis affinis* of Dr. Gray, figured in his 'Illustrations of Indian Zoology.'

It may be necessary also to call the reader's attention to two species of *Felis*, one in the volume of the 'Naturalists' Library,' *F. Servalina*, figured as *F. ornata*, which Sir W. Jardine at first considered as identical with Dr. Gray's species with the last-mentioned name, but which Dr. Gray considered to be distinct. The figures of both *F. ornata*, Gray ('Illustr. Ind. Zool.'), and *F. Servalina*, Jardine, have small tufts on the tips of their ears, and are otherwise inclined to be lynx-like; as if they formed the passage between some of the smaller Spotted Cats and the Lynxes.

Mr. Swainson ('Natural Hist. and Classification of Quadrupeds,') having compared the two typical forms of the *Feræ* and *Raptores*, observes that it remains to be ascertained which group among the *Feræ* may be likened to the Owls, and he fixes upon the Lynxes, because Lynxes and Owls are both nocturnal animals, both have short tails and comparatively large heads; and because the Owls "are particularly remarkable for certain appendages or tufts which rise above their ears," whilst in the Lynxes the "ears are long, and from the tip of each arises a tuft of lengthened hairs, perfectly analogous to the tufts of lengthened feathers on the Horned Owls, the most typical birds of the family of *Strigidæ*." His only notice of Lynx in the 'Classification' at the end of the volume is "Lynx Antiq., ears tufted with hairs, tail short;" and it appears as the fifth and last subgenus of *Felis*, Linn., the other four being:—1. "*Leo Antiquorum*, Lions, head and neck furnished with a mane of long hair, tail tufted. 2. *Felis*, Linn., Cats, no mane, tail long, not tufted. 3. *Cynailurus*, Wag., Hunting Leopards, claws semi-retractile; and, 4. *Prionodon*, Horsf., affinities uncertain."

The Lynxes may be divided into two groups: the first consisting of those species whose bodies are comparatively slender, and whose tails and tufted ears are comparatively long; the second of those whose bodies are thicker and stout, and whose ears and tail are comparatively short. The Caracal is an example of the first subdivision; and the European and the Canada Lynxes of the second. Sir William Jardine considers the tufts of hair at the tips of the ears as somewhat inconstant, and only present in spring, or at the commencement of the breeding season, like those adorning the ears of many squirrels.

Several forms of Lynx are found in the Old World.

Felis Caracal, the Caracal. M. Temminck describes this species, which is the Siyah Ghush, or Black-Ear, of Charleton and others, as having a pale reddish-brown fur with a vinous tinge, the red becoming paler as it reaches the lower parts. Two spots of pure white above the eyes, the uppermost on the inner side of the eye, the lower at its external angle. Termination and edges of the upper lip, chin, breast, belly, and insides of the legs, pure white; parts whence the whiskers spring, black; back of the ears at the base, deep black, more gray towards the tips, which are tufted with long black hairs. Length, 2 feet 10 inches, of which the tail measures 10 inches: average height about 14 inches.

Mr. Bennett ('Tower Menagerie') describes the Caracal as larger than the Fox, and the whole of the upper surface of the body as of a deep and uniform brown, the hairs being for the most part slightly tipped with gray; the under and inner parts nearly white; and the chin, lower lip, and two spots, one on the inner side of and above the eye, and the other beneath its outer angle, completely white; neck and throat of a lighter and brighter brown than the rest of the fur; the ears long and upright, tapering gradually to a fine tip, surmounted by a pencil of long black hairs, and black externally and whitish within; whiskers short, taking their origin from a series of black lines which occupy the sides of the muzzle; at some distance behind them, in front of the neck on each side, a short and thick tuft of lighter coloured hairs; tail 8 or 9 inches long, of the same uniform colour with the body from base to tip.

The Caracal is found in Persia, India, Barbary (Pennant); Persia, Turkey, &c. (Cuvier); the whole of Africa, from Egypt and Barbary to the extremity of Kaffraria, and the southern half of Asia, at least as far eastward as the Ganges (Bennett). The specimen from which Mr. Bennett took his description is noticed by him as a native of Bengal, and he observes that there is no difference of any importance between it and the African variety. Cuvier, to whom M. Duvaucel sent drawings of the animal from Calcutta, was convinced that this is the case. He refers to the Caracal à Longue Queue of Buffon's 'Supplement,' iii. pl. 45, and observes there is no difference between that and the others, and that the first Caracal of Buffon had a mutilated tail. Localities, Africa, Arabia, Persia (Fischer); Africa, Persia, Arabia (Lesson); Southern India and Africa (Jardine).

This species is said to follow the lion and other large beasts of prey, most probably for the purpose of feeding upon what they leave. But in addition to this it feeds on small quadrupeds and birds, the latter of which it is said to pursue actively on trees. It has obtained the name of 'lion's provider,' most probably from its dogging the footsteps of the lion, and having been found preying upon the carcasses which the former has left. According to M. Temminck, the Caracals hunt in packs like the wild dogs, and so run down their prey. Pennant, quoting Thévénot, notices their feeding on the remains of the prey which the lion leaves, and seems to confirm the account given by M. Temminck, for he states that they are often brought up tame, and used in the chase of lesser quadrupeds and the larger sorts of birds, such as cranes, pelicans, peacocks, &c. When they seize their prey, they hold it fast with their mouth and lie motionless on it. Pennant, quoting Hyde, also states that the Arabian writers, who call it Anak el Ard, say that it hunts like the panther, jumps up at cranes as they fly, and covers its steps when hunting. In captivity the Caracal is generally very ill-natured and irritable, and does not seem to hold out much promise for domestication; but we are aware that it is not safe to come to conclusions of this sort upon the evidence of an unhappy irritable animal shut up in a cage, when nature intended it for unlimited roamings. A young Caracal in the Garden of the Zoological Society at the Regent's Park was very familiar and anxious to be noticed, pleased with being caressed, and playful as a kitten. Dr. Charleton however gives evidence of the fierceness and strength of this species, for he relates that he saw one fall on a hound, which it killed and tore to pieces in a moment, though the dog defended itself to the utmost.

Caracal (*Felis Caracal*).

This animal derives its name of Caracal from the Turkish words 'kara,' black, and 'kulach,' ear: and the Persian name 'Siyah-Gush' or 'Sia-gusch' ('sia,' black, and 'gusch,' ear) is derived from the same characteristic markings.

Authors seem to concur in holding that this is the Λύγξ, Lynx, of the ancients, and though we lean strongly to this opinion, the reader should bear in mind that the latter evidently used the term to denote various animals, as Gesner well remarked. The 'lynces Bacchi variæ' of Virgil ('Georg.' iii. 264) and the skin 'maculosæ lyncis' alluded to by the same author ('Æneid,' i. 323), can hardly be held to apply to the Caracal, though Ovid's line ('Met.' xv. 413)

"Victa racemifero lyncas dedit India Baccho"

may. The truth seems to be that the ancients themselves had no very precise ideas of the animal which was accorded to Bacchus as one of his attributes. The terms Lynx, Panther, and Tiger seem to be all employed to designate this animal or these animals; and if we refer to gems or coins or other ancient monuments, the Lynces, to play somewhat unpardonably perhaps on Virgil's expression, will be found to be sufficiently 'variæ.' The animals represented on the ancient sculptures have generally the round ear of the Lion, Tiger, and Panther or Leopard; and their general contour is that of the Lion, Lioness, or Panther, and Leopard. See, for instance, No. 30, No. 37, in Room i.; Fragments of Terracottas in Room x.; No. 8 (Bacchus and Ampelus), Room iv.; No. 40 (Libera, or Female Bacchus), Room vi.; No. 12, Room iii.; and No. 7, Room ii., of the Townley Gallery in the British Museum, as represented in the 'Library of Entertaining Knowledge':—British Museum; Townley Gallery,' vols. i. and ii. The Lion's skin, with which, as well as that of the Panther and Roe, he was represented, appears on the colossal statue of Bacchus in the Elgin collection in the British Museum. ('Library of Entertaining Knowledge':—British Museum—Elgin and Phigaleien Marbles, vol. ii.) In the edition of the 'Gemmæ et Sculpturæ Antiquæ,' by Gronovius, we find in the 'Carro di Baccho,' as mentioned above, a child in a chariot driving two round-eared spotted great cats; and in the next gem, figured 'Tigre di Bacho,' also a carnelian, we have a round-eared spotless female great cat with a tuft at the end of the tail, which no panther, leopard, or lynx possesses.

In the coin of Septimius Severus, noticed in Captain Smyth's 'Catalogue,' between the figures of Hercules and Bacchus is a lynx or panther, illustrating the verse of Propertius:—

"Lyncibus ad cœlum vecta Ariadne tuis."

Nor does there occur to us any ancient statue, gem, or coin whereon the Lynx of Bacchus is represented with pointed ears tufted at the summit, the characteristic mark of that subdivision of the cats denominated Lynxes by modern zoologists; though we by no means feel sufficient reliance upon our limited experience to consider this negative evidence as conclusive. The animal in the Palestrine Mosaic, with the word 'Lynx' below it, is represented with a tail of considerable length, and cannot be mistaken for one of the animals now called Lynxes; indeed, if we do not err, the Abbé Barthélemi observes that this animal bears a strong resemblance to a horse.

That the Λύγξ of Aristotle, Ælian, and Oppian was not one of the doubtful animals above alluded to, but one of the Lynxes of modern zoologists, there can be, in our opinion, no doubt.

Ælian (xiv. 6) gives such a description of his lynxes, with the tips of their ears tufted, their leaping on their prey, and their tenacity in holding it, as cannot be mistaken; and he quotes two lines of Euripides to show that the animal he is describing is the lynx of that poet. Oppian ('Cyneget.,' iii. v. 84) also gives such an account of his lynxes as can be referrible to no other animals than those on which we are treating. He speaks of two kinds, notices their preying on hares, and leaping upon stags and oryxes.

Pennant conceived that the European Lynx was the Λύγξ of Ælian and Oppian, and the *Chaus* of Pliny; with regard to the former, we think, without due consideration. The Caracal comes much more within Oppian's description than the European Lynx. Oppian expressly notices the ruddy and yellow colours of his two kinds, but mentions no spots. The localities of the Caracal, combined with the other evidence, make it much more probable that it should be the animal designated as a Λύγξ by Aristotle and Ælian, and one, at least, of the two kinds mentioned by Oppian, if his differences were not, as they well might be, those of climate, sex, or age. Mr. Bennett ('Tower Menagerie') thinks that the Caracal is unquestionably identical with the Lynx of the ancients, though the name has been usurped in modern times for an animal of northern origin utterly unknown to the Greeks, and known to the Romans by a totally different appellation.

F. caligata, Bruce, Temm., the Booted Lynx; *F. Libycus*, Olivier; *F. Chaus*, Thumb, Geoff. (part); Lynx des Marais (part), Cuv. (Fischer).

Small, total length about three feet, of which the slender tail measures rather more than one-third, or 13½ inches; ears large, red within, tipped with a pencil of brown short hairs; sole and posterior part of the foot (leg, in common parlance) deep black; upper parts of the body bluish-gray, in some specimens fulvous, clouded with gray

Booted Lynx (*Felis caligata*).

and sprinkled with black hairs; lower parts, including the under parts of the neck and breast, reddish; thighs marked with indistinct bands of rather bright brown; two rather bright ruddy bands on the cheeks; tail at its base colour of the back, black at the tip, and with three or four incomplete rings above it, which rings are separated by intervals of a more or less pure white. The female has generally the tints more yellow. The young have well-defined dark bands upon their sides.

It is a native of Africa, from Egypt and Barbary to the Cape of Good Hope, and of the south of India.

The Booted Lynx preys upon birds and small quadrupeds; of the former the guinea-fowl is much sought after by the African varieties. Like others of the subdivision, it will make a good meal on carrion, and feast on the remains of larger quadrupeds which have fallen before the great beasts of prey.

Felis Chaus (Güldenst.), the Chaus; Lynx des Marais (part), Cuvier; Mota Rahu Manjur, or Larger Wild Cat, of the Mahrattas (Colonel Sykes).

Dr. Rüppell's figure and description have dissipated the confusion that formerly reigned with regard to this and the preceding species. He states that the Chaus is well covered with hair all over, and of this covering that which forms the ground-work is woolly, very soft, and plentifully developed; the hairs are not thickly set. The colour of the woolly hair is of a dirty palish ochre-yellow, darker on the back and lighter on the under parts; the hairs or bristles are of the same colour at bottom, have a dark-brown ring in the middle, and at the tip are of a grayish-yellow, whitish, or saffron-colour; so that the appearance produced is a mixed colouring of grayish-yellow and dirty white. Many of the hairs have a black point, and on the sides, where many lie together, they form pale black perpendicular or oblique spiral lines, and here and there single black points. The hairs of the back are of a light ochre-yellow, with points almost of a saffron-colour, and form from the shoulders to the tail a yellow stripe, which is darkest on the cross. The nose is black: above the eye is a large white spot, and below it a smaller one of the same colour. A black streak runs from the inner corner of the eye to the nose. The edges of the lips are bordered with black, and a fine white ring encircles them. The eyebrows, cheeks, and bristles of the whiskers, are white, and among the latter are a few hairs of a shining black. The inner surface of the ear, towards its outside, is bordered by tufts of hair which are white and yellow; the back of the ear is gray-brown, and the tips are brown, with terminating black tufts, half an inch in length; the cheeks, lower jaw, throat, neck, and chest are ochreous-yellow, and the belly inclines to whitish-yellow with darker spots. Externally the anterior and posterior extremities are of the general colour down to the ankles (which are dirty ochreous-yellow, and black behind), and barred with four or more black transverse bands. The inside of the limbs is yellowish, and there is a large round black spot on the fore legs. The tail is about one-fourth as long as the body, of a grayish colour, blunt and black at the point, towards which are two black rings between two grayish-white ones; but neither of these is very distinct. (Rüppell.)

Chaus (*Felis Chaus*). Rüppell.

It is a native of the north of Africa (how far up the Nile is not ascertained), in the morasses and bushy lowlands that border the Caspian Sea, and on the banks of its tributary rivers. Said to be more numerous in Persia. Noticed in Deccan by Colonel Sykes. The female that served for Dr. Rüppel's description and figure was killed at the lake of Menzale, in the Delta of Egypt.

This species haunts marshes and boggy regions, and goes hunting during the night after birds, small rodents, and fishes; it seldom climbs trees, and is not easily tamed. (Rüppell.)

The Chaus of Pliny ('Nat. Hist.,' viii. 19), which the Gauls called Raphins, with the figure of a wolf and the spots of a pard, first shown at Pompey's games, can hardly, we think, have been this animal.

Felis Lynx (Linn.), the European Lynx; Le Lynx (Buff.).—Fur long

of a dull reddish-gray above, with oblong spots of reddish-gray upon the sides, the spots on the limbs rounder and smaller; whitish below, mottled with black. Length about three feet.

European Lynx (*Felis Lynx*).

This species varies much. In winter the fur is much longer than it is in the summer, and has a hoary appearance in the former season, owing to the long hair being then tipped with grayish-white. The tail, which is black at the end, is short, not more than six or seven inches long.

Some authors confine the locality of this species to Europe; others are of opinion that it increases in numbers as it approaches the borders of Asia, which it also inhabits, and abundantly. France is considered its most northern range. It does not seem to be quite clear that *Felis cervaria* of Temminck is not a variety of this species; but *F. cervaria* inhabits the north of Asia, and skins are sent from Moscow. This is supposed to be the Kattlo of the Swedes by some, while others consider *F. Lynx* to be the Goupe of the Norwegians and the Wargelue of the Swedes. If these differences should prove to be well founded, it may be that there are two European species, or at least varieties, one inhabiting Southern Europe, not higher than France, and the warm parts of Asia, and the other inhabiting the north of Europe and Asia.

The European Lynx feeds upon small quadrupeds and birds, in search of which it often climbs trees.

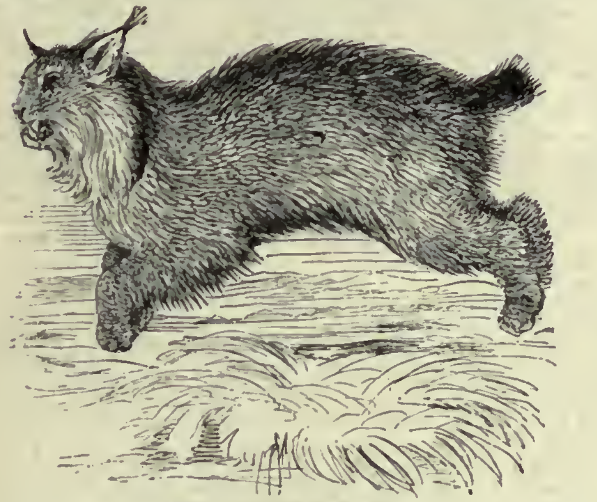
This species is supposed by many to be the *Lupus cervarius* of Pliny ('Nat. Hist.,' viii. 22), and the Chaus (viii. 19) above alluded to. Both are spoken of as shown in the arena by Pompey, and as coming from Gaul. Dr. Fischer, who is of this opinion, supposes it also to be the Lynx mentioned by Pliny in his chapter 'De Ungulis' (viii. 46).

The European and northern Asiatic Lynxes and the Canadian Lynx produce the great supply of furs known by the furriers under the name of 'lynx.' The colder the climate the fuller and the more valuable is the fur.

Felis Canadensis (Geoff.), the Canada Lynx. Sir John Richardson ('Fauna Boreali Americana') states that the early French writers on Canada, who ascribed to this species the habit of dropping from trees on the backs of deer, and destroying them by tearing their throats and drinking their blood, gave it the name of Loup Cervier. The French Canadians, he adds, now term it indifferently Le Chat, or Le Peeshoo. He remarks, that the mistake of Charlevoix in applying to it the appellation of Carcajou, which is proper to the Wolverine, has produced some confusion of synonyms amongst subsequent writers. Other writers however consider that Charlevoix intended to designate the Puma by the name of Carcajou, though he used the term improperly. If the following be the passage alluded to, it can hardly be applied to the Canadian Lynx:—"The elk has other enemies besides the Indians, and who carry on full as cruel a war against him. The most terrible of all these is the Carcajou, or Quincajou, a kind of cat with a tail so long that he twists it several times round its body, and with a skin of a brownish-red. As soon as this hunter comes up with the elk, he leaps upon him, and fastens upon his neck, about which he twists his long tail, and then cuts his jugular," &c. &c. ('Letter' vii.) Now, though there may be a little exaggeration about the length of the tail, and the use which the animal makes of it, the description is generally applicable to the Puma, and not to the Lynx, which has a mere stump of a tail, whilst the Puma has a remarkably long one.

As there is some question about this species—for Pennant notices it as identical with the European Lynx, and M. Temminck describes the species as the same in both hemispheres under the name of *Felis borealis*, whilst M. Geoffroy has named it as a distinct species—we shall give the description of Sir John Richardson, who adopts M. Geoffroy's name, at length:—

"The head is round, the nose obtuse, and the face has much of the form of that of the domestic cat, but the facial line is more convex between the eyes. The ears are erect, triangular, and tipped by an upright slender tuft of coarse black hairs; they are placed about their own breadth apart, and on their posterior surface they have a dark mark beneath the tip, which is continued near both margins downwards towards their bases. On the body and extremities the fur is hoary, most of the hairs being tipped with white; on the crown of the head and for a broad space down the middle of the back there is a considerable mixture of blackish brown, and on the sides and legs of pale wood-brown. In some specimens these colours produce an indistinct mottling, but in general there are no defined markings. A rufous tinge is also occasionally present about the nape of the neck, and on the posterior parts of the thigh. The tail is coloured like the back, except the tip, which is black. The fur is close and fine on the back, longer and paler on the belly. When blown aside it shows on the middle of the back a dark liver-brown colour from the roots to near the tip; but on the sides it is for the greatest part of its length of a pale yellowish-brown, being merely a little darker near the roots. The legs are thick, the toes very thick and furry, and are armed with very sharp awl-shaped white claws, shorter than the fur. There are four toes on each foot, those on the hind foot being rather the largest, but both feet are much spread. Length, 3 feet 1 inch," &c.



Canada Lynx (*Felis Canadensis*).

Sir John Richardson gives the following synonyms, &c.:—Loup-Cervier (Anarisqua), Sagard. Theodat.; Loup-Cervier, or Lynx, Dobbs; Cat-Lynx, Penn., 'Arct. Zool.;' Cat, or Pishu, Hutchins; Lynx, or Wild Cat, Hearne, Mackenzie; *Felis Canadensis*, Geoff., 'Ann. du Mus.,' Sabine, Franklin's 'Journ.,' 'Zoological Museum,' No. 72; Peeshoo, Cree Indians and Canadian Voyagers.

This is the only species of the genus existing north of the Great Lakes and eastward of the Rocky Mountains. It is rare on the sea-coast; does not frequent the Barren Grounds; but is not uncommon in the woody districts of the interior. Found on the Mackenzie River as far north as 66°. (Richardson.)

Timid, incapable of attacking any of the larger quadrupeds, this animal is well armed for the capture of the American hare, its principal prey. "Its large paws, slender loins, and long but thick hind legs, with large buttocks, scarcely relieved by a short thick tail, give it an awkward clumsy appearance. It makes a poor fight when it is surprised by a hunter in a tree; for though it spits like a cat and sets its hair up, it it easily destroyed by a blow on the back with a slender stick, and it never attacks a man. Its gait is by bounds, straight forward, with the back a little arched, and lighting on all the feet at once. It swims well, and will cross the arm of a lake two miles wide; but it is not swift on land. It breeds once a year, and has two young at a time." (Richardson.)

The skin of the Canada Lynx forms a considerable article in the fur trade; the annual importation by the Hudson's Bay Company is stated at from 7000 to 9000. Sir John Richardson says that the natives eat its flesh, which is white and tender, but rather flavourless, much resembling that of the American hare.

V. The Cats.

Among the smaller species of the great feline family our attention is naturally first directed towards that domestic animal which is found in almost every house. "In this case," says the author of that interesting little book 'The Menageries' (London, 12mo., 1830), "unlike that of the dog, there is no doubt which is the original head of the domesticated stock. The wild cat of the European forests is the tame cat of the European houses; the tame cat would become wild if turned into the woods; the wild cat at some period has been domesticated, and its species has been established in almost every family of the old and new continent." There is good authority for this assertion; but the origin of the domestic cat has been attributed to a very different source, and there are not wanting zoologists who even now hold that the parent stock of that useful animal is still undiscovered.

Rüppel during his first travels in Nubia discovered a cat (Kleinpfötige Katze, *Felis maniculata*) of the size of a middle-sized domestic cat, and one-third smaller than the European Wild-Cat (*Felis Catus ferus*, Linn.). All the proportions of the limbs were on a smaller scale, with the exception of the tail, which is longer in *Felis maniculata*. The woolly or ground hair is in general of a dirty ochreous, darker on the back and posterior parts, and becoming gradually lighter on the anterior and lateral parts; longer hair of a swarthy dirty white, so that the appearance of the animal is grayish-yellow. Skin of the edges of the lips and of the nose bare and black. Beard and bristles of the eyebrows shining white, brown at the roots; edges of eyelids black; iris glaring yellow. From the inner corner near the eye there is a dark-brown streak running in the direction of the nose, and there is a white streak as far up as the arch of the eyebrows; between these two streaks is another grayish one extending on the forehead by the side of the ears and under the eyes. Outside of the ears gray, inside white, and without tufts of hair. Eight slender black undulating lines arise on the forehead, run along the occiput, and are lost in the upper part of the neck. Cheeks, throat, and anterior part of the neck, shining white. Two ochreous-yellow lines spring, the one from the outer corner of the eye, the other from the middle of the cheek, and meet both together under the ear; and two rings of the same colour encircle the white neck: below the rings there are spots of ochreous-yellow. Chest and belly dirty-white, with similar spots or semicircular lines. A dark streak along the back becomes lighter as it rises over the shoulders, and darker on the cross. This streak is gradually lost on the upper part of the tail, the lower surface of which is white-yellow. The tail is almost of an equal thickness, rather slender, and with two dark rings at its point. The extremities, which have less hair in proportion on the outer side, are of the general colour, with besides five or six blackish semicircular bands on the fore legs, and six distinct dark cross-streaks on the hind legs. The inner sides are lighter in colour, with two black spots or streaks on the upper parts of the fore legs, and the hind extremities show the cross-streaks winding around the thighs towards the inside. Foot, soles, hind parts of ankles, and wrists shining black. Length 2 feet 5 inches, the tail being about 9 inches: height at the shoulder about 9½ inches. The description was taken from an aged female. M. Rüppell, who

Egyptian Cat (*Felis maniculata*).

found this cat west of the Nile, near Ambukol, in rocky and bushy regions, is of opinion that there can be no doubt that it is descended from the domestic cat of the ancient Egyptians, now to be traced in the cat-mummies and their representations on the monuments of Thebes. In the 'Description de l'Egypte, Hypogées des Thebes,' vol. ii. pl. 45, No. 14, is the representation of a cat. Plate 51, No. 3, shows a cat's mummy, and plate 54, No. 7, the skeleton of a cat's mummy which in size of body, form of head, and length of tail, accords perfectly with *Felis maniculata*. The question then arises whether this domestic cat might not have been transferred or bequeathed to the contemporary civilised Europeans by the Egyptians; and the superintendents of the Frankfort collection agree that the general facts strongly favour the opinion that *F. maniculata* is the type of our Domestic Cat. M. Temminck concurs in opinion with M. Rüppell that this Nubian species is the stock from which it sprang. Sir William Jardine, in his able 'Natural History of the Felinæ' ('Naturalists' Library,' 'Mammalia', vol. ii, small 8vo, Edinburgh and London, 1834), states that the opinion generally accepted before this by most naturalists was, that the Wild Cat of Europe was the original stock; but, he adds, that although, since the introduction of our House Cat to this country, there may have been an accidental cross with the wild native species, an attentive examination of the greater numbers will at once show a very different form from that exhibited by the Wild Cat; the most prominent distinctions being the shortness of the legs, and shortness and thickness of the tail in the latter. "The domestic cat," continues this author, "is the only one of this race which has been generally used in the economy of man. Some of the other small species have shown that they might be applied to similar purposes; and we have seen that the general disposition of this family will not prevent their training. Much pains would have been necessary to effect this, and none of the European nations were likely to have attempted it. The scarcity of cats in Europe, in its earlier ages, is also well known; and in the 10th and 11th centuries a good mouser brought a high price. Although, however, our opinion coincides with that of the above-mentioned authorities, and we think that we are indebted to the superstition of the ancient Egyptians for having domesticated the species described by Rüppell, we have no doubt that since its introduction to this country, and more particularly to the north of Scotland, there has been occasional crossing with our own native species, and that the results of these crosses have been kept in our houses. We have seen many cats very closely resembling the wild cat, and one or two that were very tame, which could scarcely be distinguished from it. There is perhaps no animal that so soon loses its cultivation, and returns apparently to a state completely wild. A trifling neglect of proper feeding or attention will often cause them to depend upon their own resources; and the tasting of some wild and living food, will tempt them to seek it again, and to leave their civilised home. They then prowl about in the same manner as their congeners, crouching among cover, and carefully concealing themselves from all publicity. They breed in the woods or thickets, and support themselves upon birds or young animals. Few extensive rabbit-warrens want two or three depredators of this kind, where they commit great havoc, particularly among the young in summer. They sleep and repose in the holes, and are often taken in the snares set for their prey. I once came upon a cat which had thus left her home: she had newly kittened in the ridge of an uncut corn-field. Upon approaching she showed every disposition to defend her progeny, and beside her lay dead two half-grown leverets."

Before we quit this part of the subject we must not forget that among the animals seen by Rüppell in Kordofan, he discovered a new small species of Cat.

Mr. Bell ('History of British Quadrupeds,' Lond. 8vo., 1827), first addresses himself to the question whether the common wild cat is the original from which all our domestic cats have sprung, according to the general opinion of the older naturalists. He states that there are many reasons for believing that this opinion is entirely erroneous. In the first place, he observes, the general conformation of the two animals is considerably different, especially in the length and form of the tail, which in the wild cat is strong, robust, and at least as large towards the extremity as at the base and middle, whilst that of the domestic cat tapers towards the apex. The fur too of the former, he remarks, is thicker and longer; and although the colours are somewhat like those which occur in some individuals of the ordinary species, there are, even in this respect, distinctions which can scarcely be considered otherwise than as essentially specific; as for instance, the termination of the tail in a black tuft, which invariably marks the wild cat. To these distinctions may be added the difference of length of the intestinal canal; though domestication might account for much of that.

But to return to Mr. Bell. With regard to the alleged crossing between the wild and the domestic breeds, "it is not without much reflection on the matter" that he has "come to the conclusion that this opinion of their intermixture, repeated and transmitted from one to another till it has become an uncontested dogma, is erroneous, and has its foundation in mistaken facts." Mr. Bell then notices Rüppell's *Felis maniculata* above described, and comes to the conclusion that "this species, to which the high authority of Rüppell has assigned the origin of our house cat, is still farther removed from it in essential zoological characters than even the British wild cat, to which it had been previously so generally referred; and that, as in the case of so many of our domesticated animals, we have yet to seek for the true original of this useful, gentle, and elegant animal."

We must confess that we do not see much difficulty in coinciding with the opinion of Rüppell, Temminck, and Sir William Jardine upon the evidence at present known. It is not attempted to be denied that the Egyptians had a domestic cat, and we think that there can be little doubt that the Domestic Cat of the Egyptians was identical with *F. maniculata.* This extraordinary people, whose existence is now only to be traced in their wonderful and enduring monuments, were, when in their high and palmy state, the centre of civilisation, and we can see no reason why other nations, who borrowed so largely from them, should not have also received their domestic cat among other benefits of civilisation. This animal, when introduced, would be liable to all the usual consequences of domestication and of intermixture, according to the localities of the various nations who obtained it. We can see no reason why the domestic cat, from whatever source derived, should not breed with the wild cat in Great Britain, and we believe that it has so bred.

The arguments derived from the difference between the tails of the Wild Cat, of the Domestic Cat, and of *F. maniculata*, do not seem to us to carry much weight. We cannot shut our eyes to the effect of domestication on this organ among the Dogs, which gives us every variety, from the well-clothed tail of the Newfoundland dog, setter, and spaniel, to that of the grayhound, which is so scantily furnished as to owe one of its excellencies to being 'tailed like a rat;' nay, in some varieties, that long tail is reduced to almost no tail at all. There are also tailless cats, as Mr. Bell himself notices.

Still the doubt thrown on the question by a zoologist of so much experience and skill as Mr. Bell is deserving of the most serious consideration, and should stimulate those who have the opportunity to investigate the subject upon every occasion offered to them.

The Domestic Cat is Le Chat of the French; Gatto of the Italians; Gato of the Spanish and Portuguese; Katze of the Germans; Cyperse Kat and Huyskat of the Dutch; Katta of the Swedes; Kat of the Danes; Cath and Gwr Cath of the Welsh; and *Felis domestica, seu Catus* of Ray. It is worthy of remark that all these names are the same as the Latin *Catus*, whence the diminutives *Catulus* and *Catellus*; and this is somewhat in favour of all northern and western Europe having received the Cat through Roman civilisation. We are thus brought nearer to Egypt, its probable origin. The Greek word 'ailúros' (αἴλουρος) is an odd one, and helps us nothing, being apparently a descriptive term. There seems to be a word in Sanscrit for cat, leading to the supposition that amongst the early Indo-Germanic races the cat was not domesticated.

The varieties of the Common Cat, as in all cases of domestication, are endless: among the most noted are the Tabby, the Tortoiseshell, the Chartreux, which is bluish, and the Angora Cat with its long silky hair. The Domestic Cat is but too famous for its attainments in the art of ingeniously tormenting, and it is difficult to say what end is answered by the prolonged agonies of fear and torture which the poor mouse is made to undergo before it receives the coup de grace. This refined cruelty appears to be confined to mice, young rats, and small quadrupeds: if a cat strikes down a bird she does not trifle with it, but, conscious of its chances of escape, bites off its head or wounds it mortally at once.

We insert the following from Pennant, though it has been often quoted, not only as illustrating the manners of a period so distant as that of Howel, who died in the year 948, after a reign of 33 years over South Wales and of 8 years over all Wales, but also on account of the reflection at the end, which we think worthy the consideration of those who are interested in inquiring whence the stock of the Domestic Cat was derived. "Our ancestors," says Pennant, "seem to have had a high sense of the utility of this animal. That excellent prince Howel Dda, or Howel the Good, did not think it beneath him, among his laws relating to the prices, &c., of animals ('Leges Walliæ,' p. 247, 248) to include that of the cat, and to describe the qualities it ought to have. The price of a kitling before it could see was to be a penny; till it caught a mouse, twopence. It was required besides that it should be perfect in its senses of hearing and seeing, be a good mouser, have the claws whole, and be a good nurse; but if it failed in any of these qualities the seller was to forfeit to the buyer the third part of its value. If any one stole or killed the cat that guarded the prince's granary he was to forfeit a milch ewe, its fleece, and lamb; or as much wheat as when poured on the cat suspended by its tail (the head touching the floor) would form a heap high enough to cover the tip of the former. This last quotation is not only curious, as being an evidence of the simplicity of ancient manners, but it almost proves to a demonstration that cats are not aborigines of these islands, or known to the earliest inhabitants. The large prices set on them (if we consider the high value of specie at that time) and the great care taken of the improvement and breed of an animal that multiplies so fast, are almost certain proofs of their being little known at that period." ('British Zoology.')

Felis Catus of Linnæus, the Wild Cat, is Le Chat Sauvage of the French; Gato Montis of the Spaniards; Wilde Katze and Baumritter of the Germans; Vild Kat of the Danes; Cath Goed of the Welsh; *Catus sylvestris* of Klein; and *Felis sylvatica* of Merrett.

Head triangular, strongly marked; ears rather large, long, triangular, and pointed. Body strong, rather more robust than that of the Domestic Cat. Tail of equal size throughout its length, or rather larger towards the extremity. Fur soft, long, and thick; colour of the face yellowish-gray, with a band of black spots towards the muzzle; whiskers yellowish-white; forehead brown; head gray, marked with two black stripes passing from the eyes over and behind the ears; back, sides, and limbs gray, darker on the back, paler on the sides; with a blackish longitudinal stripe along the middle of the back, and numerous paler curved ones on the sides, which are darker towards the back, and become obsolete towards the belly, which is nearly white. Tail annulated with light gray and black; tip of the latter colour. Feet and insides of the legs yellowish-gray; soles black, at least in the male, of which sex Temminck declares it to be a peculiarity. Colours of the female paler, and markings less distinct. Dimensions differing greatly according to the statement of various naturalists. Medium size of full-grown male:—

	Foot.	In.	Lines.
Length of head and body	1	10	0
Length of head	0	3	8
Length of ears	0	2	3
Length of tail	0	11	2

Female rather smaller. (Bell.)

Temminck gives the average length as three feet.

The Wild Cat is found in all the wooded countries of Europe, Germany especially; Russia, Hungary, the north of Asia, and Nepaul. The animal is larger in cold climates, and its fur is there held in higher estimation.

Wild Cat (*Felis Catus*).

In Britain it was formerly plentiful, and was a beast of chase, as we learn from Richard the Second's charter to the abbot of Peterborough, giving him permission to hunt the hare, fox, and wild cat. The fur in those days does not seem to have been thought of much value, for it is ordained in Archbishop Corboyl's canons, A.D. 1127, that no abbess or nun should use more costly apparel than such as is made of lambs' or cats' skins.

The Wild Cat is now rarely found in the south of England, and even in Cumberland and Westmoreland its numbers are very much reduced. In the north of Scotland and in Ireland it is still abundant.

Among the foreign Wild Cats may be enumerated *Felis Chaus*, Guld.; the Mota Rahn Manjur, or Larger Wild Cat, of the Mahrattas (a lynx); and *Felis torquatus*, F. Cuv.; the Lhan Rahn Manjur, or Lesser Wild Cat, of the Mahrattas; *Felis Moormensis*, the Moormi Cat, Hodgson, from the Moormi Hills in Nepaul ('Zool. Proc.' January, 1824). *Felis planiceps*, Vigors and Horsfield, departs in many points from the true cats, and approaches *Prionodon* in others. *Felis Temminckii* of the same zoologists, which is near the Domestic Cat in size, comes nearer in form—it is uniform in colour—to the true Tiger-Cats. We must not omit to notice the *Felis Caffra*, a specimen of which is to be seen in the South African Museum (No. 28), specimens of which have been met with, as the 'Catalogue' informs us, in whatever direction South Africa has yet been explored. "It exhibits certain fixed peculiarities which unequivocally constitute it a distinct species from the Domestic Cat, which is occasionally found wild in the colony, and with which the former has sometimes been erroneously confounded. It possesses a full share of the ferocity of the feline tribe; and dogs which have once had a specimen of its pugnacious will and power show a considerable degree of caution in encountering it a second time. It is frequently found in such flats as chance to be covered with long grass or with a moderate growth of brushwood; and when disturbed by the approach of men or dogs, usually seeks shelter in thickets, or the burrows of other animals. It preys upon small quadrupeds and birds, and is an especial enemy to those of the latter which have their nests upon the ground." ('Catalogue of South African Museum.')

We subjoin a list of the specimens of *Felinæ* in the collection of the British Museum, arranged according to the views of Dr. J. E. Gray.

Felinæ.

1. *Leo Barbarus*, the Lion; *Felis Leo*, Linn.; *Leo Africanus*, Swains.; *F. Leo Barbarus*, Fischer. North Africa.

2. *Leo Goojrattensis*, the Maneless Lion; *Leo Persicus*, Swains. (?); *Felis Leo Goojrattensis*, Smee.

3. *Leo Gambianus*, the Gambian Lion; Lion du Senegal, 'Mam. Lithog.'; *F. Leo Senegalensis*, Fischer. West Africa, interior of Gambia.

4. *Tigris regalis*, the Tiger; *Felis Tigris*, Linn., Buffon. India.

5. *Leopardus varius*, the Leopard or Panther; *Felis Leopardus* and *F. varia*, Schreb.; *F. Pardus*, Linn. (?), Cuv.; *F. minor* Ehrenb.; *F. Panthera*, Erxl.; *F. Antiquorum*, Fischer; *F. melas*, Péron; *F. chalybeata*, Herm.; *F. fusca*, Meyer. Nepaul, snowy region.

6. *Leopardus Uncia*, the Ounce; *Felis Uncia*, Schreb., Buffon; *F. Pardus*, Pallas; *F. Irbis*, Ehrenberg; *F. Panthera*, Erxl. Tibet.

7. *Leopardus neglectus*, the Gambian Leopard; *Felis neglecta*, Gray; *F. servalina*, Ogilby; *F. Senegalensis*, Lesson; *F. celidogaster*, Temm. Gambia, Western Africa.

8. *Leopardus Onça*, the Jaguar; *Felis Onça*, Linn.; *F. Yaguar*, Griffith.; *F. nigra*, Schreb.; *F. Panthera*, Schreb. Tropical America.

9. *Leopardus Serval*, the Serval; *Felis Serval*, Schreb.; *F. Capensis*, Forster; *F. Galopardus*, Desm.; Tiger Boschkatte, Cape colonists. Cape of Good Hope.

10. *Leopardus Moormensis*, the Mirvini; *Felis Moormensis*; Hodgson. Nepaul.

11. *Leopardus concolor*, the Puma; *Felis concolor*, Linn.; *F. discolor*, Schreb.; *F. Puma*, Shaw; Cougouar, Buffon; Gouazoura, Azara; *Puma*, Hernand. Canada.

12. *Leopardus Yagouarondi*, the Yagouarondi; *Felis Yagouarondi*, Lacep.; *F. Darwinii*, Martin. French Guyana.

13. *Leopardus marmoratus*, the Marbled Cat; *Felis marmorata*, Martin; *F. Diardii*, Jardine. Malacca.

14. *Leopardus pardalis*, the Ocelot; *Felis pardalis*, Linn., Schreb., Buffon; *F. Chibiguazu*, H. Smith (?); *F. Smithii*, Swains. (?); *F. Hamiltonii*, Fischer. Tropical America.

15. *Leopardus mitis*, the Chati; *Felis mitis*, F. Cuvier; *F. Onça*, Schreb., Buffon; *F. Chati*, Griffith; *F. Wiedii*, Swains. Tropical America, Guyana (?).

16. *Leopardus macrourus*, the Kuichua; *Felis macroura*, Pr. Max.; *F. Wiedii*, Sching. Mexico.

17. *Leopardus griseus*, the Gray Ocelot; *Felis armillata*, F. Cuvier. Tropical America.

18. *Leopardus pictus*, the Painted Ocelot, Gray. Tropical America.

19. *Leopardus Tigrinus*, the Margay; *Felis Tigrina*, Schreb., Buffon; *F. Margay*, Griffith; *F. Guigua*, Molina. Tropical America.

20. *Leopardus variegatus*, the Variegated Leopard. Tropical America,

21. *Leopardus tigrinoides*, the False Margay. Tropical America.

22. *Leopardus viverrinus*, the Wagati Cat; *Felis viverrinus*, Bennett, Gray; Wagati, Elliot. India.

23. *Leopardus Javanensis*, the Kubouk; *Felis Javanensis*, Horsf.; *F. minuta*, var., Temm.; *F. Diardii*, Griffith; *F. undata*, Fischer; *F. undulata*, Sching. Java.

24. *Leopardus Sumatranus*, the Balu; *Felis Sumatrana*, Horsf.; *F. minuta*, var., Temm.; *F. undata*, var., Fischer.

25. *Leopardus Chinensis*, the Maou; *Felis Chinensis*, Gray. China.

26. *Leopardus Reevesii*, the Chinese Bulu, China; *Leopardus Elliotti*, Elliott's Cat, Gray; *Felis Nepalensis*, Hodgson. Madras.

27. *Leopardus Himalayanus*, Warwick's Cat; *Felis Himalayanus*, Warwick, Jardine. India.

28. *Leopardus inconspicuus*, the Waved Cat, Gray; *Felis torquatus*, F. Cuv.; *F. Bengalensis*, Desm.; *F. Nepalensis*, Vigors and Horsf. India, Gangootra.

29. *Felis Catus*, the Wild Cat, Linn., Buffon. Scotland.

30. *Felis domestica*, the Cat, Brisson; *F. Catus Domesticus*, Schreb.

31. *Felis planiceps*, the Flat-Headed Lynx; Chaus (?); *F. Diardii*, Crawford. Sumatra.

32. *Chaus Lybicus*, the Chaus; *Felis affinis*, Gray; *F. Chaus*, Güldenst, Humb., F. Cuv.; *F. Dongolensis*, Hemp., and Ehr.; *F. caligata*, Bruce; *F. Lybicus*, Oliv.; *F. Catolynx*, Pallas; *Lynchus erythrotus*, Hodgson; *F. Kutas*, Pearson; *F. Ruppellii*, Brant. Nepaul.

33. *Chaus pulchellus*, the Smaller Chaus; *Felis pulchella*, Gray. Egypt.

34. *Chaus servalinus*, the Servaline Chaus; *Felis ornata*, Jardine; *F. servalina*, Jardine. India.

35. *Chaus Caffer*, Caffre Cat; *Felis Caffra*, Desm. (?). Cape of Good Hope.

36. *Caracal melanotis*, the Caracal; *Felis Caracal*, Buffon. Cape of Good Hope.

37. *Lyncus Canadensis*, the Peeshoo, or Canada Lynx; *Felis Canadensis*, Geoff., Richards.; *F. borealis*, Temm.; Cat-Lynx, Penn.; *Carcajou*, Charlevoix. Canada.

38. *Lyncus pardinus*, the Southern Lynx; *Felis pardina*, Oken; Loup-Cervier, Perrault. Sardinia (?), Spain, Sierra Morena.

39. *Gueparda jubata*, the Youze or Cheetah; *Felis jubata*, Schreb.; *F. guttata*, Herm.; *F. Fearonis*, A. Smith (?); *F. venatica*, H. Smith; Hunting Cat, Penn. Cape of Good Hope.

Fossil Felidæ.

In the second or Miocene period of the Tertiary Formations we have hitherto found the first traces of large Fossil Cats. There are no less than four species of these great cats, some as large as a lion, enumerated by Professor Kaup from the Epplesheim sand near Altzey, about twelve leagues south of Mayence. These remains are preserved in the museum at Darmstadt. The professor names these *Felis aphanista*, *F. prisca*, *F. ogygia*, and *F. antediluviana*. In the third and fourth (or Pliocene), divisions of the Tertiary periods, we find that the number of terrestrial herbivorous quadrupeds become more abundant; and, with their numerical importance, the *Carnivora*, whose agency was required for keeping them down, increase also. Dr. Buckland in his 'Reliquiæ Diluvianæ' mentions that Cuvier found the tusks of an extinct lion or tiger in the Breccia of Nice, and that Mr. Pentland had discovered the tooth of the same extinct tiger in the Breccia of Antibes. Bavard, the Abbé Croizet, and Jobert, in the work on 'Fossil Cats,' found, among the remains contained in the Ossiferous Rocks of Auvergne (Puy de Dôme) the following species: *Felis Issidoriensis*, *F. brevirostris*, *F. Pardinensis*, *F. Arvernensis*, and *F. Megantereon*.

The following Fossil Cats are enumerated by Von Meyer:—*Felis spelæa*; *F. antiqua*, Cuv.; *F. Issiodorensis*, Croiz. and Job.; *F. brevirostris*, Croiz. and Job.; *F. Pardinensis*, Croiz. and Job.; *F. Arvernensis*, Croiz. and Job.; *F. Megantereon*, Brav.; *F. cultridens*, Brav.; *F. aphanistes*, Kaup.; *F. ogygia*, Kaup; and *F. prisca*, Kaup.

Dr. Lund, in his 'View of the Fauna of Brazil previous to the last Geological Revolution,' remarks that the Hunting Leopard (*Felis jubata*, Linn.; *Cynailurus*, Wagl.), which differs from the rest of the Cats in many essential characters, has been very properly formed into a separate genus; for its claws are not retractile; it is gregarious, and of so mild a disposition that it is frequently tamed and employed in the chase. But, he observes, as a remarkable contrast to this, that its dental system is upon a more murderous plan than that of the true *Feles*, not having the flat projection on the large tearing molar of the upper jaw, which is found in all the other predaceous genera, and the development of which is in inverse proportion to the animal's carnivorous propensities. Dr. Lund recognised this form of dentition in a small animal of the extinct Fauna of the Brazilian region, which was the scene of his valuable labours, not exceeding a domestic cat in size; and he has named it *Cynailurus minutus*. Besides this he discovered the remains of two species of the normal feline form, one as large as the Long-Tailed Tiger-Cat (*Felis macroura*, Pr. Max.), the other larger than the Jaguar (*Felis Onça*, Linn.), and comparable to the Tiger and the Lion, the largest species of the Old World.

In his 'British Fossil Mammals,' Professor Owen describes four forms of *Felidæ*:—1. *Felis spelæa*, the Great Cave-Tiger; 2. *F. Pardoides*; 3. *F. Catus*; 4. *Machairodus latidens*.

In his account of the first Professor Owen says:—

"It is too commonly supposed that the Lion, the Tiger, and the Jaguar are animals peculiarly adapted to a tropical climate. The genus *Felis* is however represented by species in high northern latitudes, and in all the intermediate countries to the equator; and there is no genus of *Mammalia* in which the unity of organisation is more closely maintained, and in which therefore we find so little ground in the structure of a species, though it may most abound at the present day in the tropics, for inferring its special adaptation to a warmer climate. A more influential, and indeed the chief cause or condition of the prevalence of the larger feline animals in any given locality, is the abundance of the vegetable-feeding animals in a state of nature, with the accompanying thickets or deserts unfrequented by man. The Indian Tiger follows the herds of Antelope and Deer in the lofty Himalayan chain to the verge of perpetual snow. The same species also passes that great mountain barrier and extends its ravages, with the Leopard, the Panther, and the Cheetah, into Bocharia, to the Altan chain, and into Siberia as far as the fiftieth degree of latitude, preying principally on the wild horses and asses. It need not therefore excite surprise that indications should have been discovered in the fossil relics of the ancient Mammalian population of Europe; of a large feline animal the contemporary of the Mammoth, of the tichorine Rhinoceros, and of the gigantic Cave-Bear and Hyæna, and the slayer of the oxen, deer, and equine quadrupeds that so abounded during the same epoch.

"These indications were first discovered in the bone-caves of Germany; and Cuvier in his usual masterly review of the materials which were accessible up to the period of his 'Memoir' on the Cave *Carnivora* in the 'Annales du Muséum' for 1806, concludes that the most characteristic of the fossils of the great feline animal could be referred neither to the existing Lion or Lioness, nor to the Tiger, still less to the Leopard, or Panther, but that it more resembled in the curvature of the lower border of the under jaw the Jaguar.

"Mr. Goldfuss having subsequently obtained an almost entire fossil cranium of the large extinct feline animal, described it under the name of *Felis spelæa*, which name Cuvier adopted in the later edition of his great work, adding to the distinctions which Goldfuss had pointed out between the fossil and the skulls of the existing Felines, including the Jaguar, that the suborbital foramen appeared to be smaller and placed further from the margin of the orbit than in the existing Lion or Tiger. Although in the uniform and gentle curve of the upper contour of the fossil skull it resembles more that of the Leopard than any of the larger Felines, Cuvier subsequently speaks of the extinct species as a lion or a tiger. There is a constant and well-marked character, of which Cuvier appears not to have been aware, by which the skulls of the existing lion and tiger may be distinguished from one another: it consists in the prolongation backwards in the Lion of the nasal processes of the maxillary bones to the same transverse line which is attained by the upper ends of the nasal bones; whilst in the Tiger the nasal processes of the maxillary bones never extend nearer to the transverse line attained by the upper ends of the nasal bones than one-third of an inch, and sometimes fall short of it by two-thirds of an inch, where they terminate by an obtuse or truncated extremity, whilst in the Lion they are pointed. It is very desireable that this character should be determined if possible in the continental specimens of the skulls of the *Felis spelæa*. If the nasal processes of the superior maxillary bones do not extend as far backwards as the nasal bones, it may be concluded that the species was not a lion; but as the shorter processes of the superior maxillary bones are present in the skull of the Jaguar and Leopard as well as the Tiger, the approximation of the fossil to the striped or the spotted species of the genus *Felis* will depend upon other characters."

Portions of the skeleton of *F. spelæa*, more especially the teeth and jaws, have been found in the caves at Kirkdale, Kent's-Hole, Sandford Hill, Hutton, Bleadon, and North Cliff in Yorkshire.

The second species was indicated by Professor Owen from the specimens of a tooth obtained by Mr. Colchester from the Red Crag of Newbourne, near Woodbridge in Suffolk. Teeth of the Bear, Hog, and Deer have been obtained from the same locality. This species seems to have the same antiquity as the *F. aphanista* and *F. antediluviana* of Kaup, both of which were discovered by Dr. Kaup, associated with Dinetheriums and Mastodons in the Miocene of Epplesheim.

F. Catus, the Wild Cat. Fossil remains of a feline animal about the size of the Wild Cat were first noticed by Dr. Schmerling in his description of the caverns in the province of Liège, where they were found in tolerable abundance. He assigns the right ramus of a lower jaw, which exceeds by a few lines the specimen figured above, to a species or variety which he calls *Felis Catus magna*; and the greater proportion of the fossils, which include some entire skulls, to the *Felis Catus minuta*. These however do not vary from the standard of the existing Wild Cat, more than the varieties due to age or sex are now observed to do.

French naturalists have also enumerated a considerable collection of bones of the Wild Cat, discovered in the caverns of Lunel Vale.

"The most authentic specimens of the *Felis Catus*, in relation to their antiquity, which appear yet to have been obtained from British localities, are the right ramus of the lower jaw, retaining the canine tooth, discovered in the brick-earth at Grays, Essex, and a corresponding part of the lower jaw, almost identical in size and shape, but retaining the three molar teeth, from the cave of Kent's-Hole, Torquay. The Essex jaw of the Wild Cat, which was found in the same deposit that has yielded so many remains of the Mammoth, was in the usual condition of the bones of that period; and the specimen from Kent's-Hole, now in the British Museum, precisely accords in colour and chemical composition with the fossils of the extinct quadrupeds from the same cave. The outlines of the pre-molar teeth preserved in this jaw are added above the corresponding empty sockets of the jaw figured, with which they quite agree in size; and both are undistinguishable from the analogous parts of the still existing species of Wild Cat. We seem therefore here to have another instance of the survival, by a smaller and weaker species, of those geological changes which have been accompanied by the extirpation of the larger and more formidable animals of the same genus. Our household cat is probably a domesticated variety of the same species which was contemporary with the spelæan Bear, Hyæna, and Tiger. It appears, at least from an observation recorded by M. De Blainville, that Grimalkin cannot be the descendant of the Egyptian Cat, as M. Temminck supposed. The first deciduous inferior molar tooth of the *Felis maniculata* has a relatively thicker crown, and is supported by three roots; whilst the corresponding tooth in both the Domestic and Wild Cats of Europe has a thinner crown and two roots. The tail of the Domestic Cat is more tapering, and a little longer than in the Wild Cat; but the extent to which this part is shown by a curious propagated variety of tailless cat to be susceptible of modification, ought to warn us against inferring specific distinction from slight differences in the proportions of the tail." (Owen.)

Machairodus latidens. In this island, anterior to the deposition of the Drift, there was associated with the great extinct Tiger, Bear, and Hyæna of the caves, in the destructive task of controlling the numbers of the richly-developed order of the Herbivorous *Mammalia*, a feline animal as large as the tiger, and, to judge by its instruments of destruction, of greater ferocity.

In this extinct animal, as in the *Machairodus cultridens* of the Val d'Arno, and the *M. Megantereon* of Auvergne, the canines curved backwards, in form like a pruning-knife, having the greater part of the compressed crown provided with a doubly-cutting edge of serrated enamel; that on the concave margin being continued to the base, the convex margin becoming thicker there like the back of a knife to give strength, and the power of the tooth being further increased by the expansion of its sides. Thus, as in the *Megalosaurus*, each movement of the jaw with a tooth thus formed combined the power of the knife and saw, whilst the apex in making the first incision acted like the two-edged point of a sabre, the backward curvature of the full-grown teeth enabled them to retain like barbs the prey whose quivering flesh they penetrated. Three of these canine teeth were discovered by the Rev. Mr. Mac Enery in Kent's Hole, Torquay, and were recognised by Dr. Buckland as bearing a close resemblance to the canines of the *Ursus cultridens* of the Val d'Arno. Professor Nesti, to whom Dr. Buckland transmitted casts of these teeth, recognised the same resemblance, but noticed their proportionably greater breadth. The cast of one of the largest of the canines of the *Machairodus cultridens* from the Val d'Arno, presented to Professor Owen by Mr. Pentland, measures eight inches and a half in length along the anterior curve, and one inch and a half in breadth at the base of the crown. The largest of the canines of the *Machairodus* from Kent's Hole measures six inches along the anterior curve and one inch two lines across the base of the crown. The English specimens are also thinner or more compressed in proportion to their breadth, especially at the anterior part of the crown, which is sharper than in the *Machairodus cultridens.* (Owen.)

These differences are so constant and well marked in the British specimens that Professor Owen has proposed for them the above specific name.

We here figure a tooth of *Megalosaurus*, a tooth of *Machairodus* (*Ursus cultridens*), and a cast of another, from specimens in the Museum of the Geological Society of London.

a, tooth, imperfect below, natural size; *b*, outline of cast of tooth, perfect, half natural size; *c*, tooth of *Megalosaurus*, natural size.

Hitherto no parts of the skeleton of *M. latidens* have been found in England so as to throw any additional light on the organisation of this once formidable beast of prey. It must have however equalled, or nearly equalled, in bulk the Spelæan Tiger. "When we are informed," says Professor Owen, "that in some districts of India entire villages have been depopulated by the destructive incursions of a single species of large feline animal, the Tiger, it is hardly conceivable that man in an early and rude condition of society could have resisted the attacks of the more formidable Tiger, Bear, and *Machairodus* of the Cave epoch. And this consideration may lead us the more readily to receive the negative evidence of the absence of well-authenticated human fossil remains; and to conclude that man did not exist in the land which was ravaged simultaneously by three such formidable *Carnivora*, aided in their work of destruction by troops of savage hyænas."

The following is a list of the species of *Felis* to be seen in the Zoological Gardens, Regent's Park:—

F. Leo, var. *Goojrattensis*, Smee; *F. Leo*, Linn. Morocco, Nubia, Ushantee, Mozambique	Lion.
F. Tigris, Linn. Goa, Baroda, Bengal	Tiger.
F. Onça, Linn. Orinoco, Amazon	Jaguar.
F. Pardus, Linn. Western Africa, South Africa, Ceylon, India, Malacca	Leopard.
F. Leopardus, Schreber. Morocco	Panther (?).
F. jubata, Sch. Nubia, South Africa	Cheetah.
F. pardalis, Linn. South America	Ocelot.
F. mitis, F. Cuvier. South America	Ocelot.
F. melanura, Ball. Demerara	Ocelot.
F. ——— (?). Peru	Ocelot.
F. macrocelis. Java	Riman-Dihan.
F. Tigrina, Schreber. South America	Ocelot.
F. Serval, Schreber. South Africa	Serval.
F. Servalina, Ogilby. Gambia	Western Serval.
F. viverrina, Bennett. Bengal	Wagati.
F. Chaus, Guldeustedt. Egypt	Marsh Cat.
F. Caracal, Schreber. Gambia, Bombay, Nubia	Caracal.
F. Canadensis, Geoffroy. North America	Canadian Lynx.
F. concolor, Linn. North America, Chili, Amazon	Puma.
F. Eyra, Desmarest. Paraguay (?)	Eyra.

FELIS. [FELIDÆ.]

FELSPAR, a Mineral which occurs in every part of the earth, and is one of the constituents of granite.

It occurs crystalline and massive. The primary form of the crystal is an oblique rhombic prism. Colour white, gray, green, red, of different shades. Transparent, translucent, or opaque. Lustre vitreous. Specific gravity, 2·5 to 2·6. Hardness, 6·0. Streak grayish-white. Cleavage parallel to the terminal plane and oblique diagonal. Fracture conchoidal, uneven. There are several varieties. That known by the name of *Adularia* occurs in large crystals, especially in Mont St. Gothard. *Moonstone* is a variety which has a pearly lustre, and when cut and polished is chatoyant; the finest specimens of this are from Ceylon. *Sunstone* is similar, but contains minute scales of mica. *Aventurite* Felspar often owes its iridescence to minute crystals of specular or titanic iron. The massive varieties are amorphous. Structure granular, compact. A green variety has been found in Siberia. The several varieties differ but little in composition. *Adularia*, which is one of the purest varieties, according to Vauquelin, consists of:—

Silica	64
Alumina	20
Potash	14
Lime	2
	—100

Felspar is distinguished from *Scapolite* by its more difficult fusibility, and by a slight tendency to a fibrous appearance in the cleavage-surface of the latter, especially in massive varieties; from Spardumare by its blow-pipe characters. Felspar is one of the constituents of granite, gneiss, mica-slate, porphyry, and basalt, and often occurs in these rocks in crystals. Dana says St. Lawrence county, New York, affords fine crystals; also Orange county, New York; Haddam and Middletown, Connecticut; South Royalston and Barre, Massachusetts; besides numerous other localities. Green Felspar occurs at Mount Desert, Maine; an Aventurine Felspar at Leyperville, Pennsylvania; *Adularia* at Haddam and Norwich, Connecticut; and Parsonsfield, Maine. A Fetid Felspar (sometimes called *Necronite*) is found at Roger's Rock, Essex county; at Thomson's Quarry, near 196th-street, New York city, and twenty-one miles from Baltimore. Carlshad and Elbrogen in Bohemia; Baveno in Piedmont; St. Gothard; Arendal in Norway; Land's End, England; and the Mourn Mountains, Ireland, are some of the more interesting localities. The name Felspar is a German word, '*feld*' meaning field.

Felspar is used extensively in the manufacture of porcelain. Moonstone and Sunstone are often set in jewellery. They are polished, with a rounded surface, and look somewhat like cat's-eyes, but are much softer.

Kaolin.—This name is applied to the clay that results from the decomposition of Felspar. It is the material used for making porcelain or china-ware. The change the Felspar undergoes in producing Kaolin consists principally in a removal of the alkali-potash, with part of the silica, and the addition of water. Composition of a specimen from Schneeberg (Berthier):—

Silica	43·6
Alumina	37·7
Peroxide of Iron	1·5
Water	12·6

It occurs in extensive beds in granite regions, where it has been derived from the decomposition of this rock. A granite containing talc seems to be the most common source of it. [ROCKS.]

FENESTE'LLA, a beautiful and abundant genus of Fossil *Zoophyta*, allied to *Retepora*, which occurs in the whole Palæozoic series. (Lonsdale, 'Sil. System,' &c.)

FENNEC, the name of a species of *Canis*, the *C. Zerda* of Gmelin.

FENNEL. [FOENICULUM.]

FENUGREEK. [TRIGONELLA.]

FERÆ, the third order of *Mammalia*, according to Linnæus. The following is his character of the order:—Upper incisor teeth (primores) six, rather acute (acutiusculi); canine teeth solitary. The order contains the following genera:—1. *Phoca* (the Seals); 2. *Canis* (the Dogs, Wolves, Foxes, Hyænas, and Jackals); 3. *Felis* (the Cats, Lions, Tigers, Leopards, Lynxes, and smaller cats); 4. *Viverra* (the Ichneumons, Coatis, Skunk (*Putorius*), Civets, and Genets); 5. *Mustela* (the Otters, Glutton, Martens, Pole-Cats, Ferrets, and Weasels, including the Ermine, &c.); 6. *Ursus* (Bears, Badgers, and Racoons); 7. *Didelphis* (the Opossums); 8. *Talpa* (the Moles); 9. *Sorex* (the Shrews); 10. *Erinaceus* (the Hedgehogs). Linnæus places the *Feræ* between the orders *Bruta* and *Glires*.

FERGUSONITE, a crystallised mineral, which is principally a Columbate of Yttria. It has been found only in Greenland, near Cape Farewell, imbedded in quartz.

Its primary form is a square prism. Colour brownish-black. Opaque, except in the splinters. Lustre slightly metallic. Specific gravity 5·838. Hardness 5·5 to 6·0. Streak pale brown. Fracture conchoidal. Before the blow-pipe becomes of a greenish-yellow, and does not fuse, but with a phosphate it dissolves completely. According to Hartwall, this mineral consists of

Oxide of Columbium	47·75	
Yttria	41·91	
Zirconia	3·02	
Oxide of Cerium	4·68	
Oxide of Tin	1·00	
Oxide of Uranium	0·95	
Oxide of Iron	0·34	
		99·65

FERNS, the common name for a group of Cryptogamous Plants. [FILICES; DANÆACEÆ; LYCOPODIACEÆ; POLYPODIACEÆ; MARSILEACEÆ; OPHIOGLOSSACEÆ.]

FERO'NIA, the name of a genus of Plants belonging to the natural order *Aurantiaceæ*. The flowers are often polygamous. The petals are usually 5 in number, occasionally 4 or 6, spreading. The calyx is flat and 5-toothed. Stamens 10; filaments dilated and united at the base; anthers linear-oblong, tetragonal. The ovary is seated on the elevated disc, 5- or occasionally 6-celled; ovules numerous in each cell. It has scarcely any style and an oblong stigma. The fruit is inclosed in a hard rind, 5-celled and many seeded, which seeds are immersed in a fleshy pulp. The leaves are pinnated with from 5 to 7 leaflets nearly or quite sessile, very slightly crenulated, with pellucid dots along the margin, inconspicuously dotted elsewhere: the racemes are axillary, terminal, and few-flowered.

F. Elephantum is the Elephant-Apple or Wood-Apple of the Coromandel coast, where it is very generally eaten. The branches of this tree are armed with small spines. The leaflets, which vary in number from 5 to 7, are small, obovate and smooth; when very young they are thin, and when bruised have a most fragrant smell resembling anise. The native practitioners of India consider them stomachic and carminative. After a certain age however the leaves become tough and almost coriaceous. The fruit is fleshy, and extremely acid before it arrives at maturity; but when ripe, it contains a dark-brown agreeable subacid pulp. In appearance the fruit is large, spheroidal, rugged, and often warted externally: the seeds are in five parcels, and are flat and woolly, adhering to the branched placentæ by means of long cords.

A transparent oily fluid exudes from the trunk of this tree when an incision is made into it, which is used by painters for mixing their colours. A clear white gum may also be obtained from the tree very much resembling gum-arabic. The wood is likewise valuable on account of its durability, whiteness, and hardness.

F. pellucida has leaves full of transparent dots; the common petiole round, pubescent; this tree usually attains a height of 20 feet, and is a native of the East Indies, where the fruit is generally eaten. The flowers are white.

In cultivation these trees thrive well in a mixture of turfy loam and peat: and ripened cuttings will strike root in sand under a glass exposed to heat.

(Lindley, *Flora Medica*; Don, *Dichlamydeous Plants*.)

FERRET. [MUSTELIDÆ.]

FERRO-TANTALITE. [COLUMBITE.]

FE'RULA, a genus of Plants belonging to the natural order *Umbelliferæ*, whose species often yield a powerful stimulating gum-resin employed in medicine. It differs from *Pastinaca* and *Peucedanum* by its fruit having several vittæ in each channel, and from *Opoponax*, which it otherwise resembles, in the margin of the fruit being thin and flat, not thickened and convex. The fruit is in appearance extremely similar to that of a parsnip; it is compressed from the back till it is extremely flat, and it thins away at the edge. There are three approximated filiform dorsal ridges, and the two lateral ones are distant, obsolete, or lost in the edge. In each channel there are three or more vittæ, and on the commissure four, or a great many. The flowers are always yellow, and the stem solid, its cavity being filled with a spongy substance, in which fibres are vaguely dispersed.

The drugs called Sagapenum and Assafœtida were supposed to be produced by species of this genus, but by which in particular it was not known with certainty. Dr. Falconer has shown that Assafœtida at least is produced by another genus, which he calls *Narthex*. [NARTHEX.]

F. Assafœtida is found in only two districts of Persia, namely, the fields and mountains of Herat, the capital of Khorassan, and the range of mountains in the province of Lar (Laristan), extending from the river Cur as far as the town of Congoon, along the coast of the Persian Gulf. Kæmpfer states that even here the plants do not always yield the drug; that it is only those of the desert near Herat and of the mountains round Disguun in Laristan that furnish it; and he figures a plant, with a naked simple stem, clothed with leafless sheaths, umbels without involucre, a coarse woody root rising above the ground, and pinnated leaves with pinnatifid segments and oblong obtuse lobes. This plant is the *Ferula Assafœtida* of Linnæus and De Candolle; what is supposed to be it has since been met with in Beloochistan, and Lieutenant Burnes saw what he calls *Assafœtida* growing in great luxuriance in the mountains of Hindu-Koosh at an elevation of 7000 feet. He states that it is an annual, and grows to the height of 8 or 10 feet, when it withers and decays. The milk which it exudes is first white, and then turns yellow and hardens, in which state it is put in hair bags and exported. Sheep browse upon the tender shoots, which are believed to be highly nutritious. ('Travels,' ii. 243.) It is however by no means certain that this was true Assafœtida. Indeed if it was, as Lieutenant Burnes states, an annual, it must have been some other plant; for Kæmpfer expressly describes the root of Hingisèh, or Assafœtida, as "ad plures annos restibilem, magnam, ponderosam, nudam," and in fact it is from wounds in this root that the gum-resin flows. It is probable that Assafœtida is yielded by different plants. Professor Royle obtained seeds of two kinds from the bazaar of India; and it appears from a communication made to Mr. Macneill from a medical gentleman at Soomeeana in Beloochistan, that in that province a kind of *Ferula* called Hooshee yields a similar product, which however is not collected.

The *F. Assafœtida* is said to arrive at as great an age as man himself, and in consequence its roots sometimes attain a considerable size. It is from wounds in this part that the drug is obtained. The roots are not wounded before they are four years old; the greater their age the better the quality of their produce. There were four operations each year when Kæmpfer visited the country; the first in the middle of April, the second at the latter end of May, the third ten days later, and the fourth in the beginning of July. The gatherers on the first occasion only cleared the hard sandy or stony soil away from the root to the depth of a span or so, pulling off the leaves, replacing the earth about the roots, and then heaping the leaves on them, pressing them down with a stone. On the subsequent occasions they slice the roots transversely, beginning a little below the top, and collecting the juice that flows from the wounds. After every operation they cover the root with the old leaves to screen it from the sun. After the last gathering the screens are thrown away and the roots are left to perish. Dr. Falconer believes his Narthex Assafœtida to be identical with Kæmpfer's plant.

F. Persica, a perennial species with a glaucous stem and supradecompound leaves with linear cut segments, has been reported to yield assafœtida. Dr. Hope entertained this opinion, from which Nees and Ebermaier do not dissent. Treviranus found it yielding a substance extremely like assafœtida in the botanic garden of Breslau; and the same thing has often occurred in the Apothecaries' Garden at Chelsea. Nevertheless, Fée suspects, after Willdenow, that it is rather the origin of sagapenum. Olivier believed it to produce gum ammoniacum; but according to Professor Don that drug is yielded by his *Dorema ammoniacum*.

F. orientalis has also been quoted as the source of gum ammoniacum; and it appears that such a substance is really produced, either by that plant or a nearly allied species, in the empire of Marocco.

F. ferulago has been taken for the plant which furnishes galbanum; but Professor Don states that this drug is really yielded by quite a different genus, called by him *Galbanum officinale*. [ASSAFŒTIDA, in ARTS and SC. DIV.]

FERUSSI'NA, a genus established by M. Grateloup for a Fossil Turbinated Shell from Dax, which seems at first view very near the *Anostomata*, but which M. Grateloup thinks, from the examination of its aperture, approximates more to the *Cyclostomata*, an opinion in which M. Rang concurs, adding that the species, three or four, are all fossil.

Animal unknown. Shell oval, globulous; aperture round, bordered, oblique, simple, toothless, "retournée du côté de la spire;" umbilicus more or less large; operculum (?).

FESCUE-GRASS. [FESTUCA.]

FESTU'CA, a genus of Plants belonging to the natural order of Grasses, containing several species of agricultural importance. It is known among British Grasses by having many-flowered spikelets, the lower paleæ of which are neither awned as in *Bromus*, nor blunt as in *Poa* and its allies, but terminated gradually in a hard sharp point.

F. pratensis, or Meadow Fescue, is about three feet high, with a nearly upright branched 1-sided panicle and broad coarse leaves. It is a native of moist meadows, and forms a portion of most good meadow herbage. Mr. Sinclair states that in point of early produce this grass ranks next to Meadow Fox-Tail (*Alopecurus pratensis*), and is much more productive.

F. ovina, *F. rubra*, and *F. duriuscula* are other agricultural grasses, much smaller than the last, and contributing greatly to the value of pastures. *F. ovina* has a fine succulent foliage, and, according to Linnæus, sheep have no relish for hills on which it does not abound; it is however unproductive. *F. rubra* is more abundant in its produce, but less nutritious; and its creeping root-like stems are said to impoverish the soil very much. *F. duriuscula* is preferrible to both the preceding; it withstands dry weather better than most grasses, and in combination with *F. pratensis* and *Poa trivialis* forms excellent pasturage. It is most prevalent on light rich soils. *F. dumetorum*, another species, will thrive in dry sandy situations, to which property its value is chiefly owing; but its nutritive qualities are slight, and it is altogether an inferior species.

(Babington, *Manual of British Botany*.)

FETTBOLL, a soft hydrous Silicate of Alumina allied to Halloylite. [HALLOYLITE.]

FEUILLEA, a genus of Plants belonging to the natural order *Cucurbitaceæ*, and named in honour of Louis Feuillée, a traveller in Chili, the author of several works on botany. The flowers of this genus are diœcious. The staminiferous flowers have the calyx 5-cleft beyond the middle; 5 petals rather joined at the base; 5 stamens inserted with the petals, and alternating with them; sometimee there are 10 stamens, but when this occurs 5 of them are always sterile. The pistilliferous flowers have the tube of the calyx adnate to the ovarium, with a 15-cleft limb. They have 5 petals, distinct or joined at the base, and oblong; 3 styles. Stigmas broad and bluntly bifid. Fruit globose, fleshy, with a circular scar round the middle and five other scars, 3-celled, with a solid bark, and a large fleshy trigonal central axis. The ovules are numerous, standing erect upon the axis. The seeds oval and compressed. Cotyledons flat and rather fleshy. This genus is a native of the tropical regions of America, and most of the species are frutescent climbing herbs. They have alternate, stalked, cordate, smooth leaves, and small flowers. The tendrils are axillary, spirally twisted, in place of peduncles. The seeds are oily and of a bitter taste; their unctuous matter causes them to be used for burning, and their excessive bitterness renders them good anthelmintics; they are also cathartic.

F. punctata has 3-lobed or ternate leaves, beset with glandular dots on both surfaces along the nerves, but more especially beneath. The lobes of the leaves are lanceolate and rather cut. It is a native of St. Domingo.

F. trilobata has leaves which are rather glandular on both surfaces, 3-parted or trifid, the lower lobes obtuse, the upper ones acute. This species is a native of Brazil. It is the *F. scandens* of some authors, and the celebrated Nhandirhoba or Ghandirhoba of South America, where it is held in great repute as an antidote to various poisons, animal and vegetable. The natives employ it not only against serpent-bites but also to counteract the baneful effects of the Manihot and Manchineel. M. Drapiez, after having made experiments expressly to test its power, states that animals poisoned with hemlock, nux-vomica, *Rhus*, *Toxicodendron*, &c., were restored by the administration of the seeds of this plant. He recommends that the seeds be bruised in a little water, and asserts that it is equally efficacious as an antidote whether taken internally or applied to a poisoned wound. These seeds act with great rapidity as emetics and purgatives. The oil expressed from them is used as an application in pains in the joints.

F. cordifolia has glandless cordate acuminate leaves, somewhat 3-lobed and rather serrated. It is a native of the West Indies, and has likewise a reputation as a preventive of the ill effects of vegetable poisons, and as an emetic and purgative.

F. Javilla has glandless roundish leaves, sinuately cordate, and acuminate. It is a native of New Granada in the woods near Turbaco, where it is known by the name of Javilla. The seeds have winged margins; hence this species agrees with the genus *Zanonia*.

The fruit of the *Feuillea* is as large as an apple, and from a fancied resemblance it is called the Shaving-Box.

A light rich soil is found to suit best the species of *Feuillea*, and cuttings will easily take root in a hot-bed or glass frame exposed to heat. Being creeping plants they are well adapted for training up rafters in stoves.

(Don, *Dichlamydeous Plants*; Lindley, *Flora Medica*; Burnett, *Outlines of Botany*.)

FEVERFEW. [MATRICARIA; PYRETHRUM.]

FIBER. [BEAVER.]

FIBRE, ANIMAL. [FIBRIN; FIBROUS TISSUE.]

FIBRE, VEGETABLE, one of the most elementary forms of vegetable tissue. It consists of excessively delicate threads, twisted spirally in the interior of a cell or tube. It is uncertain whether the fibre is solid or hollow, its tenuity being such as to baffle all microscopical observers who have yet examined it. It is this elementary fibre which, being turned spirally round a long delicate tube with its spires in contact, forms the elastic spiral vessel. It occurs in the interior of common cells, when its turns cross each other and produce a netted appearance. It is frequent in the cellular tissue which forms the lining of an anther, and is supposed to have some connection with the opening of that organ. In its naked state, uncombined with membrane, it is supposed to be very rare. On the surface of some seeds, as *Collomia linearis*, it has been observed in this condition in great abundance, in the form of spiral threads of a highly elastic nature.

Vegetable Fibre should not be confounded with the woody fibre of plants, which consists of tough straight tubes either single or adhering in bundles. It is this which forms the thread of hemp, flax, and the like. [TISSUES, VEGETABLE.]

FIBRIN, an organic proximate principle found in both plants and animals. When obtained from wheaten flour it is called Gluten. It has the same properties whether obtained from vegetable or animal sources. In the animal kingdom it is found in the muscles and the blood. [BLOOD.] The fibrin of the blood is best obtained by what is called whipping the blood, that is, by rapidly stirring a quantity of fresh-drawn blood with a spoon or a piece of stick. During this process the blood coagulates, and the coagulum adheres to the spoon or stick. The red particles which are mixed with this coagulum may be removed by washing it in large and repeated portions of water; the substance that remains is Fibrin nearly in a state of purity.

During the state of life the fibrin is contained in solution in the fluid part of the blood, the liquor sanguinis. Professor Müller obtained fibrin in a state of purity from frog's blood by opening one of its large arteries, or by laying bare and incising the heart itself. This blood being received into a watch-glass and the process of coagulation watched, it was observed that previously to the complete coagulation of the blood there formed a small colourless coagulum clear as water. "Having brought a drop of pure blood," says Müller, "under the microscope, and diluted it with serum, so that the blood-corpuscles lay completely scattered about and separated from each other, I observed that in the interval between the blood-corpuscles a coagulum of previously dissolved matter was produced, by which the whole separated blood-globules were connected together. I was then able to remove at the same time all the blood-corpuscles, notwithstanding their wide distribution and the size of the intervals between them, by raising with a needle the fibrous coagulum occupying the intervening spaces. As the blood-corpuscles of the frog are rendered by a microscope uncommonly large, this observation admits of the greatest distinctness, and allows no ambiguity to remain on the subject. There is still however an easier and more convincing method of proving that fibrin is dissolved in frog's blood. As I showed from experiment that the blood-corpuscles of the frog are about four times larger than the blood-corpuscles of men and *Mammalia*, I concluded that perhaps the filter would keep them back, while it allowed the corpuscles of men and *Mammalia* to pass. This is the case. The experiment may be made on a small scale with the blood of a frog alone: a small glass-funnel and a filter of common white filtering-paper, or thick printing-paper, are the only requisites. The paper must previously be moist, and it is well to add an equal quantity of water to the fresh blood of the frog. The liquid which flows through the filter is an almost colourless clear serum diluted with water, with a slight tinge of red, from the colouring matter dissolved by the water. As however the solution of the colouring matter of frog's blood by water requires a considerable time, the filtered fluid can scarcely be termed reddish, and is sometimes quite colourless. If instead of water a solution of sugar in water (one part of sugar to 200 or more of water) be employed, no colouring matter will be dissolved during the filtration, and the filtered liquid is quite colourless and without the slightest trace of mixture. If the filtered serum be examined under the microscope no trace of corpuscles can be detected. In this clear serum in the course of a few minutes a colourless coagulum is formed, so clear and transparent that it is not even detected after its formation until it is raised out of the fluid with a needle. It gradually thickens, and becomes whitish and fibrous; it then assumes gradually the appearance of the coagulum of human lymph. In this way the fibrin of the blood is obtained in the purest state, and this has not hitherto been done."

Pure fibrin is of a whitish colour, inodorous, and insoluble in cold water; it is a solid substance, tough, elastic, and composed of thready fibres.

The relative quantity of fibrin contained in the blood varies greatly, according to the state of the system at the time it is obtained.

Fibrin and Albumen, if not identical, are very closely allied, and appear rather to differ in organisation than in essential chemical character. For an account of the relations of Fibrin and Albumen see PROTEIN.

That variety of fibrin which constitutes muscular fibre is so interwoven with nerves, vessels, and cellular and adipose tissue, that its properties are probably always more or less modified by foreign matters. "To obtain the fibrin of a muscle, it must be finely minced and washed in repeated portions of water at 60° or 70° till all colouring and soluble substances are withdrawn, and till the residue is colourless, insipid, and inodorous; it is then strongly pressed between folds of linen, which renders it semi-transparent and pulverulent. Berzelius observes that in this state it becomes so strongly electro-positive when triturated, that the particles repel each other and adhere to the mortar, and that it still retains fat, which is separable by alcohol or ether. When long boiled in water it shrinks, hardens, and yields a portion of gelatine, derived from the interstitial cellular membrane; the fibrin itself is also modified by the continued action of boiling water, and loses its solubility in acetic acid, which when digested with it in its previous state forms a gelatinous mass, soluble in water, but slightly turbid from the presence of fat and a portion of insoluble membrane, derived apparently from the vessels which pervaded the original muscle. It is soluble in diluted caustic potass, and precipitated by an excess of muriatic acid, the precipitate being a compound of fibrin with excess of muriatic acid, and which when washed with distilled water become gelatinous and soluble, being reduced to the state of a neutral muriate of fibrin.

"When the fibrin of muscle is mixed with its weight of sulphuric acid it swells and dissolves, and when gently heated a little fat rises to the surface, and may be separated: if the mass is then diluted with twice its weight of water, and boiled for nine hours (occasionally replacing the loss by evaporation), ammonia is formed, which combines with the acid; and on saturating it with carbonate of lime, filtering, and evaporating to dryness, a yellow residue remains, consisting of three distinct products: two of these are taken up by digestion in boiling alcohol of the specific gravity of ·845, and are obtained upon evaporation; this residue, treated with alcohol of the specific gravity of ·830, communicates to it (1) a portion of a peculiar extractive matter, and the insoluble remainder (2) is white, soluble in water, and crystallisable, and has been called by Braconnot leucine. It fuses at 212°, exhaling the odour of roasted meat, and partly sublimes: it is difficultly soluble in alcohol. It dissolves in nitric acid, and yields on evaporation a white crystalline compound, the nitro-leucic acid. The portion of the original residue, which is insoluble in alcohol (3), is yellow, and its aqueous solution is precipitated by infusion of galls, subacetate of lead, nitrate of mercury, and persulphate of iron. It appears therefore that the products of the action of sulphuric acid upon the fibrin of muscle are, 1, an extractive matter soluble in alcohol; 2, leucine; and 3, extractive, insoluble in alcohol, but soluble in water." (Brande.)

FIBROFERRITE, a Mineral consisting of Sulphate of Iron. [IRON.]

FIBROLITE, a name for Bucholzite. [BUCHOLZITE.]

FIBROUS TISSUE. The tissue specially called fibrous consists of the membrane that covers the bones and cartilages (the periosteum and perichondrium); the membrane that is spread over or that forms a part of certain muscles, constituting the muscular aponeuroses or fasciæ; the membrane that forms the sheaths in which tendons are included; the outer membrane that envelopes the brain and spinal chord (the dura mater and its continuation down the spinal canal); the firm membrane in which the more delicate muscles and the humours of the eye are contained (the tunica sclerotica); the outer membrane forming the bag that contains the heart (the pericardium); the membranes by which the bones in general are tied together and the joints in particular are secured, called ligaments; and the firm cords in which many muscles terminate and which form their moveable extremities, termed tendons. Though these substances are extensively diffused through the body, and are apparently independent of each other, yet they are closely connected together, and form a peculiar system. The firm and resisting threads which constitute the basis of these different organs are composed of condensed cellular tissue. The peculiar animal substance of which they consist is coagulated albumen and gelatine, intermixed with a small quantity of mucous and saline matter.

All the proper fibrous organs possess, in the language of anatomists, a low organisation; that is, they receive but a comparatively small quantity of blood, and their blood-vessels are so minute in size, that they are generally incapable of admitting the red particles of the blood. They receive few nerves, and these are so small that some anatomists have doubted whether they are supplied with any nerves at all; but their sensibility in certain states of disease proves that they are not absolutely destitute of sentient nerves. In like manner, few absorbents can be traced to them; yet the ravages of disease in the neighbourhood of joints, the sloughing of tendons, and the destruction of the periosteum by the pressure of aneurism, abundantly testify that they are supplied with absorbent vessels. But the office of all the fibrous organs is mechanical; they are adapted either to contain, support, and defend more delicate organs, or they constitute strong and unyielding bands which tie joints firmly together. A high degree of organisation, great vascularity, great sensibility, would have disqualified them for their office. What they principally need is a power of cohesion sufficient to enable them to resist rupture, and to sustain the opposing shocks to which the joints are exposed in the violent movements of the body; the less sensibility they have the better, and accordingly they are so organised that while their physical properties render them by far the strongest parts of the animal frame, they are endowed only with just a sufficient degree of vitality to constitute them integrant parts of the living system. [AREOLAR TISSUE.]

FIBULA. The Fibula (péroné, Fr., περόνη, a bodkin) is a long slender bone swelling out at both ends, by which it is firmly attached to the outer side of the tibia, or main bone of the leg. The lower extremity forms the projection of the outer ancle: it is received into a deep longitudinal groove at the side of the tibia, to which it is connected by a ligamentous union; and is firmly knit to the foot by strong bands of ligament, which spread like the sticks of a fan from the tip of the ancle to the bones of the heel and instep. The upper extremity slants a little backwards, and is articulated with the side of the tibia below the knee, by means of a true joint, having cartilaginous surfaces and a synovial membrane as well as external ligaments. The tendon of the biceps flexor cruris, or muscle of the outer hamstring, is implanted into this part of the fibula, which is called its head, and spreads over the adjoining bony and muscular surfaces, connecting and supporting them in the double capacity of a ligament and an aponeurosis. There is no greater degree of motion between the tibia and fibula than is sufficient to give some elasticity to the play of the ancle-joint, which is secured on the outer side chiefly by the projection of the fibula beyond it. The shaft of the fibula—nearly straight, triangular, hard, a little twisted, and of great strength for its size—is about as thick as the middle finger, and extends like a bowstring across the arch formed by the gradual enlargement of the tibia towards the knee. A strong sheet of fibrous membrane, called the interosseous ligament, tightly stretched from one bone to the other, fills up the greater part of the interval between them, and gives surface for the attachment of muscles and strength to the limb, without adding inconveniently to its bulk or weight. Nine muscles are attached to the fibula. The biceps cruris, already mentioned, bends the leg back towards the thigh; three on the fore part raise and extend the toes, the remaining five unite in raising the heel, and press the toes and the ball of the foot against the ground; at the same time turning the sole outwards by lifting its external border. The muscles chiefly concerned in the last-mentioned action are the peroneus longus and brevis; their tendons pass behind the ancle, lying in a groove of the fibula, which acts as a fixed pully to change the line of their traction, and are inserted into two bones on the outer and inner edge of the sole near the base of the toes. They are very powerful muscles; and when they act with sudden and spasmodic force, in consequence of the foot coming unexpectedly to the ground, are capable of breaking the fibula above the ancle by pressing the foot against its projecting end. This accident happens not unfrequently from the foot slipping unawares over the edge of the curb-stone, and is complicated with various degrees of lateral dislocation, and with severe sprain of the ligaments of the inner ancle. The force may be sufficient to break off the tip of the inner ancle; and if the sharp edge of the broken tibia be driven through the skin, which sometimes happens, the cavity of the joint is exposed, and the injury becomes a compound dislocation of the ancle-joint. These accidents are sometimes secondary, the foot being in the first instance forced by the weight against the inner ancle, with sprain of the external ligaments, and then drawn up with a jerk by the peronei. However produced, the injury is a very serious one, and often requires much good management to prevent permanent lameness or even worse consequences. Minor degrees of it have a general resemblance to simple sprains of the ligaments, and the fracture of the fibula may be overlooked. It may however be easily detected, notwithstanding the swelling, by the unusual position of the foot, and by pressing the bones together higher up the leg; for if the fibula be fractured, this cannot be done without a sense of yielding of the otherwise solidly compacted parts, and increase of pain to the patient from the pressure of the broken end of the bone against the soft parts. From the name of the eminent surgeon who first delineated and described this injury, it is called 'Pott's Fracture.' [FOOT; TIBIA.]

FIBULARIA. [ECHINIDÆ.]

FICARIA, the genus to which *Ranunculus Ficaria*, the Pilewort, has been referred. [RANUNCULUS.]

FICEDULA. [BECCAFICO; SYLVIADÆ.]

FICHTELITE, a form of Fossil Resin found in coal.

FICOIDEÆ. [MESEMBRYACEÆ.]

FICUS, a large genus of Plants belonging to the natural order *Urticaceæ*, having the flowers, both males and females, mixed indiscriminately on the inside of a fleshy receptacle, which is so concave that its edges are drawn together into a narrow opening. This is illustrated by the common eatable Fig, the receptacle of *Ficus Carica*, which, although resembling a fruit as simple as a gooseberry, is in fact a collection of a large number of minute unisexual flowers growing to a succulent base; at its apex will be found the narrow opening where the edges of the receptacle are drawn together, and when its interior is laid bare the flowers are seen closely packed all over its surface, divided from each other by soft colourless bristle-like bracts or scales. What are called the seeds in the ripe fig are the pericarps, each of which contains a single seed. The calyx is variable in the number of its segments, sometimes having only 3, sometimes 7 or 8. The stamens are solitary in many species, 3 in others, and 5 in some. The pistil consists of a single ovary terminated by an awl-shaped style, ending in a 2-lobed stigma.

The number of species of *Ficus* is very considerable, perhaps as great as that of any arborescent genus. They are all either tropical or inhabitants of warm countries. Some are small plants creeping upon the surface of rocks and walls, or clinging to the trunks of trees like ivy; others are among the largest trees of the forest. All travellers in the woods of South America speak of the noble aspect of the fig-trees (meaning species of *Ficus* not of the cultivated sort), of their gigantic dimensions, and of the thick delightful shade cast by their leafy heads. They are especially remarkable for throwing out roots from their branches, which, after they have reached the ground and established themselves there, increase rapidly in diameter, produce other branches, and thus contribute to extend an individual over a considerable space of ground. Frazer speaks thus of what he saw of their habits in the forests at Moreton Bay in Australia:—"I observed several species of *Ficus* upwards of 150 feet high, enclosing immense iron-bark trees, on which originally the seeds of these fig-trees had been deposited by birds. Here they had immediately vegetated, and thrown out their parasitical and rapacious roots, which adhering close to the bark of the iron-tree had followed the course of its stem downwards to the earth, where, once arrived, their progress of growth is truly astonishing. The roots of the *Ficus* then increase rapidly in number, envelop the iron-bark, and send out at the same time such gigantic branches that it is not unusual to see the original tree, at a height of 70 or 80 feet, peeping through the fig, as if itself were the parasite on the real intruder. In the singular angles or walls, as they are here termed, which are formed by the roots of these trees, and of which I observed many 16 feet high, there is room enough to dine half-a-dozen persons. The fruit is eagerly sought by Regent Birds (*Sericulus chrysocephalus*), blue pigeons, and Swamp Pheasants (*Cuculus Phasianus*), and the spreading and massy boughs support a number of superb parasitical plants." Reinwardt assures us ('Ueber den Charakter der Vegetation auf den Inseln des Indischen Archipels') that he observed on the island of Semao a large wood whose trunks all proceeded from one single stem of a *F. Benjamina*, all united with each other by their branches though the trunks were distinct. The well-known *F. Indica*, or Banyan-Tree, is another instance of this peculiar habit.

The species abound in a milky juice containing caoutchouc, and there is every reason to believe that what of this substance comes from Java is exclusively procured by tapping different species of *Ficus*. The best known on the continent of India is yielded by *F. elastica*.

Although the fruit of *F. Carica* and some others is eatable, yet the whole genus abounds in an acrid highly dangerous principle, diffused among the milky secretion. This is perceptible even in the common fig, whose milk produces a burning sensation on the tongue and throat; but when the fruit of that species is ripe, the acridity is destroyed by the chemical elements entering into new combinations. In some species it is so concentrated that they are among the most virulent of poisons. *F. toxicaria*, a Sumatra species, and *F. dæmona*, from Tanjore, derive their names from this circumstance, in which many more equally participate.

Ficus Indica, the Banyan-Tree, is a native of most parts of India, both on the islands and the mainland. Roxburgh states that it is found in its greatest perfection and beauty about the villages on the skirts of the Circar Mountains. The leaves are ovate, heart-shaped, 3-ribbed, and entire; when young, downy on both sides; when old, much smoother; they are from 5 to 6 inches long, and from 3 to 4 inches broad; at the top of the leafstalk on the under side is a broad, smooth, greasy-looking gland. The figs when ripe grow in pairs from the axils of the leaves, are downy, and about the size and colour of a middle-sized red cherry. The wood is light, white, porous, and of no value. The Brahmins use the leaves as plates to eat off; birdlime is manufactured from the tenacious milky juice. If the seeds drop in the axils of the leaves of the Palmyra-Tree (*Borassus flabelliformis*), the roots grow downwards, embracing the trunk in their descent; by degrees they envelop every part except the top, whence in very old specimens the leaves and head of the Palmyra are seen emerging from the trunk of the Banyan-Tree as if they grew from it. The Hindoos regard such cases with reverence, and call them a holy marriage instituted by Providence. The Banyan-Tree, covering with its trunks a sufficient space to shelter a regiment of cavalry, and used as a natural canopy for great public meetings, has been so often described by writers on India as to have become familiar to the reader. The branches spread to a great extent, dropping their roots here and there, which as soon as they reach the ground rapidly increase in size till they become as large as and similar to the parent trunk, by which means the quantity of ground they cover is almost incredible. Roxburgh says that he has seen such trees full 500 yards round the circumference of the branches, and 100 feet high, the principal trunk being more than 25 feet to the branches, and 8 or 9 feet in diameter. Gum lac is obtained from this tree in abundance. The white glutinous juice is applied to the mouth to relieve tooth-ache; it is also considered a valuable application to the soles of the feet when cracked and inflamed. The bark is supposed to be a powerful tonic by the Hindoos. An excellent account of such a tree will be found in the 'Oriental Annual' for 1834; and a graphic description of the mode of growth in Rumf's 'Herbarium Amboinense,' vol. iii. p. 126. See also 'Asiatic Researches,' vol. iv. p. 310. It is called Vuta in Sanscrit, Bur or But in Bengáli, Bagha in Cingalese.

Ficus elastica, the Indian Caoutchouc-Tree, is now a common tree in the hothouses of this country. It has large, shining, oval, pointed, thick leaves, small axillary uneatable fruits the size of an olive, and long pink or red terminal buds, composed of the stipules rolled together. This species inhabits the Pundua and the Juntipoor Mountains, which bound the province of Silhet on the north, where it grows to the size of a European sycamore, and is called Kasmeer. It is chiefly found in the chasms of rocks and over the declivities of mountains among decomposed rocks and vegetable matter. It produces when wounded a great abundance of milk, which yields about one-third of its weight of caoutchouc. It grows with great rapidity; a tree is described as being 25 feet high, with the trunk a foot in diameter when only four years old. The juice of this valuable plant is used by the natives of Silhet to smear over the inside of baskets constructed of split rattan, which are thus rendered water-tight. Old trees yield a richer juice than young ones. The milk is extracted by incisions made across the bark down to the wood, at a distance of about a foot from each other, all round the trunk or branch up to the top of the tree, and the higher the more abundant is the fluid said to be. After one operation the tree requires a fortnight's rest, when it may be again repeated. When the juice is exposed to the air it separates spontaneously into a firm elastic substance, and a fetid whey-coloured liquid. Fifty ounces of pure milky juice taken from the trees in August yielded exactly 15½ ounces of clean-washed caoutchouc. This substance is of the finest quality, and may be obtained in large quantities. It is perfectly soluble in the essential oil of Cajeput. (Roxb., 'Fl. Ind.,' iii. 545.)

F. religiosa, the Pippul-Tree, is a large tree common in every part of India, especially near houses, where it is planted for the sake of its extensive dark grateful shade. It is held in superstitious veneration by the Hindoos, because their deity Vishnoo is fabled to have been born under its branches. The leaves are heart-shaped, long, pointed, wavy at the edge, not unlike those of some poplars; and as the footstalks are long and slender, the leaves actually tremble in the air like those of the Aspen-Tree (*Populus tremula*). Silk-worms prefer the leaves next to those of the Mulberry. The leaves are used for tanning leather by the Arabs, who call the tree Mudáh or Vudáh, and also Uadi Zebid. See 'Asiatic Researches,' iv. 309, for further information concerning this.

F. Sycomorus, the Sycomore-Fig, is a large tree found in Egypt, where it is planted extensively by the road-side, near villages, and on the sea-coast, for the sake of the shelter of its very widely-spreading branches. The Arabs call it Djummeiz. Forskähl states that its head is often forty yards in diameter. The leaves are broadly ovate, repand, or somewhat angular, rather blunt, nearly smooth, heart-shaped at the base. The figs are not produced upon the young branches, but in clustered racemes upon the trunk and the old limbs. They are sweet and delicate, and eaten by the Egyptians. The timber appears to be of little value, for Forskähl excludes it from the lists of carpenters' wood, and places it among the trees which are used for firewood. It can hardly therefore have furnished the wood of which mummy-cases were made, as has been supposed. Professor Don, with greater reason, conjectures that they were made from the timber of *Cordia Myxa*. When old this tree becomes very gnarled and broken, as is shown in a plate in Salt's 'Abyssinia,' where it is figured under the name of Daroo-Tree, but it is so bare of foliage as to be hardly a picturesque object.

F. Carica, the Common Fig, is a small crooked tree or large bush with round green or russet branches, covered with a coarse short down. The leaves are rough on the upper side, coarsely downy beneath, cordate, 3- to 5-lobed or almost entire, coarsely serrated. The fruit is solitary, axillary, more or less pear-shaped, or almost round, succulent, sweet and pleasant to the taste. All the parts abound in an acrid milky juice, which produces a burning disagreeable sensation in the fauces.

FIDDLE-FISH. [SQUALIDÆ.]

FIELDFARE. [TURDUS.]

FIG. [FICUS.]

FIGURE-STONE. [SLATE.]

FIGWORT. [SCROPHULARIA.]

FILA'GO, a genus of Plants belonging to the natural order *Compositæ*, tribe *Senecionideæ*, sub-tribe *Gnaphalieæ*, division *Helichryseæ*. The outer florets are female, filiform in several rows, the outermost ones intermixed with the inner scales of the involucre or paleæ; central florets few, hermaphrodite, tubular. Pappus capillary. The receptacle conical with a scaly margin. Involucre sub-conical, imbricated, the scales lanceolate, and longer than the florets. The species of this genus were formerly referred to *Gnaphalium*.

F. Germanica is a cottony plant with yellow florets, the stem proliferous at the summit from 4 to 12 inches long. It has lanceolate wavy leaves, heads in axillary and terminal globose clusters, the outer involucral scales cuspidate, cottony, with glabrous points. It is a native of Great Britain, as well as the following species:—

F. minima is distinguished by having its stem dichotomously branched, and the outer involucre scales bluntish, cottony, with glabrous points. The florets are yellow with very small heads. Like the other species it is found in dry, sandy, and gravelly places.

F. Gallica has linear, acute, revolute leaves, the heads conical in axillary terminal clusters, shorter than the leaves. This species is very rare.

F. apiculata has a cottony stem proliferous at the summit, the leaves all oblong, blunt, apiculate, the heads prominently 5-angled, half-sunk in tomentum, forming lateral, axillary, and terminal clusters, surrounded and overtopped by one or two blunt leaves. It smells like tansey. The stem is mostly erect, with short branches below. The heads are rather large, 10 to 20 in a cluster.

(Babington, *Manual of British Botany*.)

FILAMENT, in Botany, the part of the stamens which bears the anther. It is sometimes long and slender, hence its name filament. In some plants however it is nearly or altogether absent, and not unfrequently flat and broad. [STAMEN.]

FILARIA. [ENTOZOA.]

FILBERT. [CORYLUS.]

FILE-FISH. [BALISTES.]

FI'LICES, or FILICA'CEÆ, a natural order of Plants, being the highest group of the class *Cryptogamia*, or Acrogens. The species are flowerless plants, consisting of leafy fronds, which are produced from a rhizoma unfolding in a spiral manner, and traversed by veins which form definite parts on the under surface, and produce unilocular, rarely multilocular, cases containing reproductive sporules.

The parts of these plants which require most attention in their study, and on modifications of which modern classifications depend, are the veins and organs of reproduction. The veins are either produced equally from both sides of a midrib, or they radiate from the base or axis of development, or from one side of an eccentric or unilateral costa. They are either simple, or once or repeatedly dichotomously branched, or the primary veins are pinnate; the branches either simple or forked. Their apices are either free or they are combined by various forms of anastomosis. The organs of reproduction consist of a sporangiferous receptacle, which is a thickened point or lengthened portion of the ultimate veuules or veinlets. It is generally superficial, sometimes immersed in the substance of the frond, or considerably elevated, and then globose or columnar. The sporangia, thecæ, or spore-cases, are transparent, globose, oval, or pyriform unilocular cases, each girded by a more or less complete elastic articulated ring, or destitute of a ring; then sometimes oblong, opaque, and multilocular, and usually pedicillate. The sori are collections of sporangia, and have the same form, position, and direction as the receptacles. They are either naked, or each sorus is furnished with a membranaceous covering of various forms which rises from the receptacle. This covering is called an indusium, and is a plane, or vaulted, or cup-shaped membrane, produced from the receptacle of each sorus, and is generally deciduous as it becomes replicate. Often the entire margin (or lobules of the frond) is changed in texture, and forms an accessory indusium. Sometimes the whole of the sori of each segment are included within a universal indusium which is formed by the revolute margin of fertile contracted fronds.

The following account of the reproduction of the Ferns is given in a Report to the British Association in 1851, on the higher Cryptogamous Plants, by Mr. Henfrey. Speaking of the Ferns, Mr. Henfrey says:—

"This class formed for a long time the great stumbling-block to those who sought to demonstrate the existence of sexuality in plants. The young capsules were generally considered to be the analogues of the pistillidia of the Mosses, and the young abortive capsules which frequently occur among the fertile ones were supposed by some authors to represent the antheridia. Mr. Griffith noticed a structure which he was inclined to regard as the analogue of the antheridium in certain of the ramenta upon the petioles.

"In the year 1844 Professor Nägeli published an account of his observations on the germination of certain ferns, and announced the discovery of moving spiral filaments closely resembling those of the *Charæ*, on certain cellular structures developed upon the pro-embryo or cellular body first produced by the spore. It is not worth while to enter into an analysis of his observations, as they have since been clearly shown to have been very imperfect; it is sufficient to state that he only described one kind of organ, and from his description it is evident that he confounded the two kinds since discovered, regarding them as different stages of one structure. The announcement of this discovery seemed to destroy all grounds for the assumption of distinct sexes, not only in Ferns but in the other Cryptogams, since it was argued that the existence of these cellular organs, producing spiral filaments, the so-called spermatozoa, upon the germinating fronds, proved that they were not to be regarded as in any way connected with the reproductive processes.

"But an essay published by the Count Suminski in 1848 totally changed the face of the question, and opened a wide field for speculation and investigation on this subject, just as it was beginning to fall into disfavour. Count Suminski's paper gives a minute history of the course of development of the Ferns, from the germination of the spore to the production of the regular fronds; and he found this development to exhibit phenomena as curious as they were unexpected. The cellular organs seen by Nägeli were shown to be of two perfectly distinct kinds, and moreover to present characters which gave great plausibility to the hypothesis that they represented reproductive organs; moreover, this author expressly stated that he had obtained absolute proof of sexuality by observing an actual process of fertilization to take place in the so-called ovules, through the agency of the spiral filaments or spermatozoa. The main points of his paper may be briefly summed up as follows:—The fern-spore at first produces a filamentary process, in the end of which cell-development goes on until it is converted into a Marchantia-like frond of small size and exceedingly delicate texture, possessing hair-like radicle threads on its under side. On this under side become developed, in variable numbers, certain cellular organs of two distinct kinds. The first, which he terms antheridia, are the more numerous, and consist of somewhat globular cells seated on and arising from single cells of the cellular Marchantia-like frond. The globular cell produces in its interior a number of minute vesicles, in each of which is developed a spiral filament, coiled up in the interior. At a certain epoch the globular cell bursts, and discharges the vesicles, and the spiral filaments moving within the vesicles, at length make their way out of them, and swim about in the water, displaying a spiral or heliacal form, and consisting of a delicate filament with a thickened clavate extremity; this, the so-called head, being said by Count Suminski to be a hollow vesicle, and to be furnished with six or eight cilia, by means of which the apparently voluntary movement of the filament is supposed to be effected.

"The second kind of organ, the so-called 'ovules,' are fewer in number and present different characters in different stages. At first they appear as little round cavities in the cellular tissue of the pro-embryo, lying near its centre, and opening on the under side. In the bottom of the cavity is seen a little globular cell, the so-called 'embryo-sac.' It is stated by Count Suminski that while the ovule is in this state one or more of the spiral filaments make their way into the cavity, coming in contact with the central globular cell. The four cells bounding the mouth of the orifice grow out from the general surface into a blunt cone-like process, formed of four parallel cells arranged in a squarish form, and leaving an intercellular canal leading down to the cavity below. These four cells become divided by cross septa, and grow out until the so-called ovule exhibits externally a cylindrical form composed of four tiers of cells, the uppermost of which gradually converge and close up the orifice of the canal leading down between them. Meanwhile the vesicular head of one of the spiral filaments has penetrated into the globular cellule of the embryo-sac, enlarged in size and undergone multiplication, and in the course of time displays itself as the embryo, producing the first frond and the terminal bud, whence the regular fern-stem is developed. In considering the import of these phenomena, the author assumes the analogy here to be with the process of fertilisation in flowering plants, as described by Schleiden, regarding the production of the embryo from the vesicular head of the spermatozoa as represcuting the production of the phanerogamous embryo, from the end of the pollen tube after it has penetrated into the embryo-sac.

"The promulgation of these statements naturally attracted great attention, and since they appeared we have received several contributions to the history of these remarkable structures, some confirmatory, to a certain degree, of Suminski's views; others altogether opposed to them.

"In the early part of 1849 Dr. Wigand published a series of researches on this subject, in which he subjected the assertions of Suminski to a strict practical criticism; the conclusions he arrived at were altogether opposed to that author's views respecting the supposed formation of the organs, and he never observed the entrance of the spiral filaments into the cavity of the so-called ovule. About the same time M. Thuret published a series of observations on the 'Antheridia of Ferns.' In these he merely confirmed and corrected the statements of Nägeli respecting the antheridia, and did not notice the so-called ovules.

"Towards the close of the same year Hofmeister confirmed part of Suminski's statements, and opposed others. He stated that he had observed distinctly the production of the young plant (or rather the terminal bud for the new axis) in the interior of the so-called ovule; but believed the supposed origin of it from the end of the spiral filament to be a delusion. He regards the globular cell at the base of the canal of the ovule as itself the rudiment of the stem, or embryonal vesicle (the embryo originating from a free cell produced in this), analogous to that produced in the pistillidia of the Mosses. He also describes the development of the ovule differently, saying that the canal and orifice are opened only at a late period by the separation of the contiguous walls of the four rows of cells.

"About the same time appeared an elaborate paper on the same subject by Dr. Hermann Schacht, whose results were almost identical. He found the young terminal bud to be developed in the cavity of one of the so-called ovules, which were developed exactly in the same way as the pistillidia of the Mosses. He stated also that the cavity of the ovule is not open at first, and he declares against the probability of the entrance of a spiral filament into it, never having observed this, much less a conversion of one into an embryo. In the essay of Dr. Mettenius, already referred to, an account of the development of the so-called ovules is given. His observations did not decide whether the canal of the ovule, which he regards as an intercellular space, exists at first, or only subsequently, when it is entirely closed above. Some important points occur in reference to the contents of the canal. The contents of the canal in a mature condition consist of a continuous mass of homogeneous tough substance, in which fine granules, and here and there large corpuscles, are embedded. It reaches down to the globular cell, or embryo-sac, and is in contact with it. This mass either fills the canal or diminishes in diameter from the blind end of the canal down to the embryo-sac; in other cases it possesses the form represented by Suminski, having a clavate enlargement at the blind end of the canal, and passing into a twisted filament below; in this latter shape it may frequently be pressed out of isolated ovules under the microscope, and then a thin transparent membrane-like layer was several times observed on its surface. In other cases the contents consisted of nucleated vesicles, which emerged separately or connected together.

"The embryo-sac consists of a globular cell containing a nucleus, and this author believes that the commencement of the development of the embryo consists in the division of this into two, which go on dividing to produce the cellular structure of the first frond.

"With regard to the contents of the canal the author says, 'Although I can give no information on many points, as in regard to the origin of the contents of the canal of the ovule, yet my observations on the development of the ovule do not allow me to consider them, with Suminski, as spiral filaments in course of solution; just as little have I been able to convince myself of the existence of the process of impregnation described by that author. It rather appears to me that the possibility of the entrance of the spiral filaments and the impregnation cannot exist until the tearing open of the blind end of the canal in the perfectly-formed ovule, as after the opening of the so-called 'canal of the style' in the pistillidia of the Mosses.'

"Another contribution has been furnished by Dr. Mercklin, the original of which I have not seen, but depend on analyses of it published in the 'Botanische Zeitung,' and the 'Flora' for 1851, and further in a letter from Dr. Mercklin to M. Schacht, which appeared in the 'Linnæa' at the close of last year.

"He differs in a few subordinate particulars from M. Schacht, in reference to the development and structure of the prothallium, or pro-embryo, and of the antheridia and spiral filaments; but these do not require especial mention, except in reference to the vesicular end of the spiral filament described by Schacht, which Mercklin regards as a remnant of the parent vesicle, from which the filament had not become quite freed. The observations referring to the so-called ovule, and the supposed process of impregnation, are very important; they are as follows:—

"'1. The spiral filaments swarm round the ovule in numbers, frequently returning to one and the same organ.

"'2. They can penetrate into ovules. This was seen only three times in the course of a whole year, and under different circumstances; twice a spiral filament was seen to enter a still widely open young ovule, then come to a state of rest, and after some time assume the appearance of a shapeless mass of mucilage; the third case of penetration occurred in a fully developed ovule through its canal; it therefore does not seem to afford evidence of the import of the spiral filament, but certainly of the possibility of the penetration.

"'3. In the tubular portion of the ovule, almost in every case, peculiar club-shaped granular mucilaginous filaments occur at a definite epoch; these filaments, like the spiral filaments, acquiring a brown colour with iodine. These mucilaginous bodies sometimes exhibit a twisted aspect, an opaque nucleus, or a membranous layer, peculiarities which seem to indicate the existence of an organisation.

"'4. These club-shaped filaments are swollen at the lower capitate extremity, and have been found in contact with the embryo-sac, or globular cell, which forms the rudiment of the future frond.

"'5. The spiral filaments, which cease to move and fall upon the prothallium, are metamorphosed, become granular, and swell up.'

"Hence the author deduces the following conclusions:—

"'That these clavate filiform masses in the interior of the ovule are transparent spiral filaments, which at an early period, while the ovule was open, have penetrated into it; which leads to the probability that—

"'1. The spiral filaments must regularly penetrate into the ovules; and 2. They probably contribute to the origin or development of the young fruit frond (or embryo). In what way this happens the author knows not, and the details on this point given by Suminski remain unconfirmed facts.'

"An important point in this essay is the view the author takes of the whole process of development in this case. He regards it as not analogous to the impregnation in the *Phanerogamia*, since the essential fact is merely the development of a frond from one cell of the prothallium, which he considers to be merely one of the changes of the individual plant, while all the other authors who have written on the subject, with the exception of Wigand, call the first frond, with its bud and root, an Embryo, and regard it as a new individual; or at all events, even a distinct member of a series of forms, constituting collectively the representatives of the species.

"Finally, Hofmeister, in his notice of this essay in the 'Flora,' declares that the development of the so-called embryo, or first frond, commences not by the subdivision of the globular cell, or embryo-sac, but by the development of a free cell, or embryo vesicle in this, like what occurs in the embryo-sac of the *Phanerogamia;* and he asserts that this is the first stage of development from the globular cell in all the vascular Cryptogams, including that found in the pistillidia of the Mosses."

The position of the Ferns in a natural system of classification has not been a matter of much difference. Their imperfect organs of reproduction have at once led to their being placed by most botanists among *Cryptogamia;* nevertheless Bory St.-Vincent elevates Ferns to the rank of a class intermediate between Monocotyledons and Acotyledons, or *Cryptogamia;* at the same time he rejects the view of Jussieu, who, from the mode of germination of their sporules, placed the Ferns among the Monocotyledons. Their relation with the flowering plants is seen through *Cycadaceæ*, with which order they agree in their gyrate vernation and their pinnate leaves. Their affinity with Cryptogamic Plants is obvious in the *Equisetaceæ* and *Lycopodiaceæ*. The order of Ferns may be divided into the following sub-orders, which Lindley regards as of the rank and value of orders:—

I. Gleicheniaceæ. The thecæ with a transverse or obliquely transverse complete elastic annulus or ring, bursting vertically. The species are tropical, or extra-tropical only in the Southern Hemisphere, of a harsh and rigid texture, simple or generally with copious dichotomous branches and gemmæ in the axils; the ultimate branches pinnatifid. None of the genera of this order, as understood by Hooker, are British. It includes about forty species.

II. Polypodiaceæ, with the sori dorsal, often near or at the margin, various in form, sometimes constituting an uniform linear or spreading mass, naked or furnished with an involucre, the thecæ 1-celled, with a longitudinal or oblique elastic articulated generally incomplete ring, bursting transversely and irregularly. This is a very extensive sub-order: the species inhabit almost every part of the world, from the tropics to the arctic and antarctic regions; they are exceedingly variable in size and appearance, including the largest tree-ferns and the smallest herbaceous species. It contains by far the largest number of genera of any of the sub-orders of Ferns. Many of these are very extensive, and have no British representatives, as *Cyathea*, *Hemitelia*, *Alsophila*, *Dicksonia*, &c.

III. Osmundaceæ has the thecæ with an operculiform ring, or without one, reticulated, striated with rays at the apex, bursting lengthwise, and usually externally. The species of this sub-order are not numerous.

IV. Danæaceæ. The thecæ sessile, without any ring, concrete into multilocular sub-immersed masses, opening at the apex. This is also a small sub-order, with three genera—*Danæa*, *Marattia*, and *Kaulfussia*.

V. Ophioglossaceæ. The thecæ single, roundish, coriaceous, opaque, without ring or cellular reticulation, half 2-valved, with a straight vernation. It embraces the genera *Ophioglossum*, *Helminthostachys*, and *Botrychium*.

The following is an arrangement of the British genera of Ferns:—

Sub-Order *Polypodiaceæ*.

Tribe *Polypodieæ*. The sori nearly circular, without an indusium.
Genera, *Allosorus*, *Polypodium*, *Woodsia*.

Tribe *Aspidieæ*. The sori nearly circular, covered by an indusium.
Genera, *Lastrea*, *Polystichum*, *Cystopteris*.

Tribe *Asplenieæ*. The sori oblong or linear, covered by an indusium opening longitudinally on one side.
Genera, *Athyrium*, *Asplenium*, *Scolopendrium*.

Tribe *Grammitideæ*. The sori elongate, without an indusium.
Genus, *Ceterach*.

Tribe *Adiantariæ*. The thecæ covered by a marginal or sub-marginal elongated part of the frond, or by a separated portion of the cuticle, resembling an indusium.
Genera, *Blechnum*, *Pteris*, *Adiantum*.

Tribe *Hymenophylleæ*. The thecæ opening irregularly; the ring oblique, eccentric, transverse, complete; the receptacle terminating a vein at the margin of the frond.
Genera, *Trichomanes*, *Hymenophyllum*.

Sub-Order *Osmundaceæ*.

Tribe *Osmundeæ*. The vernation circinate; the rachis solid; the thecæ stalked.
Genus, *Osmunda*.

Sub-Order *Ophioglossaceæ*.

Genera, *Ophioglossum*, *Botrychium*.

The Ferns have a wide geographical distribution. The herbaceous and shrubby kind being found towards the north and south poles: whilst the tree-ferns rival the gigantic palms in the forests of tropical climates. It is these last which give a peculiar character to the vegetation of the countries where they grow, as their foliage and stems differ altogether from any that are observed amongst flowering plants. The proportion which they bear to other plants varies much in different parts of the world. In Jamaica they are in the proportion of 1 to 9; in New Guinea as 28 to 122; in New Ireland as 13 to 60; in the Sandwich Islands as 40 to 160; on continents they are less numerous; in equinoctial America 1 to 36; in Australia 1 to 37; in France 1 to 63; in Portugal 1 to 116; in the Greek Archipelago 1 to 227; in Egypt 1 to 971. In the north their proportions are greater; they form in Scotland 1 to 31; in Sweden 1 to 35; in Iceland 1 to 18; in Greenland 1 to 10; and the North Cape 1 to 7.

The properties and uses of the Ferns are not in proportion to their numbers in the vegetable kingdom. Many of them deposit starch in their rhizomata, from which food may be prepared. The roots of

Nephrodium esculentum are eaten in Nopaul; those of *Angiopteris erecta* are used in the same manner in the Sandwich Islands. *Diplazium esculentum*, *Cyathea medullaris*, *Pteris esculenta*, and *Gleichenia dichotoma*, all yield starch, and are employed as food in different countries. [CYATHEA.] The *Adiantum Capillus Veneris* yields astringent and aromatic secretions. [ADIANTUM.] Some of the American polypodiums are said to possess powerful medicinal effects, and are used as anti-rheumatic, anti-venereal, and febrifugal remedies. The *Angiopteris erecta* yields an aromatic oil, which is used in the Sandwich Islands to perfume the fixed oils, as cocoa-nut oil. The stems of many species contain bitter principles, and have hence been used as tonics. Species of *Aspidium* and *Asplenium* have been used in European medicine. [ASPIDIUM; ASPLENIUM.] The Brazilian negroes form tubes for their pipes from the stems of *Mertensia dichotoma*. *Osmunda regalis* had at one time a great reputation in medicine.

(Babington, *Manual of British Botany*; Lindley, *Natural System*; Hooker, *Species Filicum*; J. Smith, *The Genera of Ferns*; *Journal of Botany*, vol. iv.; Newman, *History of British Ferns*; Burnett, *Outlines of Botany*; Meyen, *Pflanzen-Geographie*.)

FIN. [FISH.]

FINCH. [BULLFINCH; CHAFFINCH; COCCOTHRAUSTES; FRINGILLA.]

FINGER. [SKELETON; HAND.]

FINGERLING, the young of the Salmon. [SALMONIDÆ.]

FINSCALE. [LEUCISCUS.]

FIR. [ABIES; PINUS.]

FIRE-FLAIRE. [TRYGON.]

FIRE-FLY. [ELATERIDÆ; LAMPYRIDÆ.]

FIRE-STONE, a local term for the Upper Greensand, as it occurs along the edges of the chalk-hills south of London, as at Mesterham and Petersfield. (Fitton, 'On Greensand,' in 'Geol. Trans.')

FIROLA. [NUCLEOBRANCHIATA.]

FISH (French, Poisson; German, Fisch), a name applied to all the species of a class of animals occupying the lowest station of the four great divisions of the section *Vertebrata*.

A Fish may be defined as a Vertebrate Animal, breathing through the medium of water by means of branchiæ, or gills, having one auricle and one ventricle to the heart, cold red blood, and extremities formed for swimming.

In considering fishes, perhaps the most important thing which offers itself to our attention is the apparatus called the Branchiæ, or Gills. This apparatus is situated on each side of the neck, and consists of numerous laminæ fixed on arches. These laminæ are covered with innumerable blood-vessels, and are so constructed as to present a considerable surface to the water, so that the blood may receive a sufficient portion of the oxygen contained in that element. As the water in contact with the gills becomes deteriorated, it is necessary that a constant current be caused to flow over them. In most fishes this is effected by their taking the water in at the mouth and expelling it from under the gill-covers. The blood, which is constantly sent to the branchiæ from the heart, is distributed by means of the arteries to every part of the body, whence it returns to the heart by means of the veins.

the fore legs constituting what is termed the Pectoral Fins (*fig.* 1, *a*), and the posterior extremities the Ventral (*fig.* 1, *b*); besides these fins ordinary fishes are furnished with one or two Dorsal Fins (*fig.* 1, *c c*), an Anal Fin (*fig.* 1, *d*), and a Caudal Fin, or tail.

All these fins are not always present, nor when present are they always in the same relative positions; and we shall hereafter find that both the absence of certain fins, and the peculiar position of these organs, afford characters in the classification of fishes. The fins consist of a thin elastic membrane supported by rays. The rays are of two kinds—those which consist of a single bony piece, usually hard and pointed, are termed spinous rays; and when the rays are formed of numerous portions of bone united by articulations, and frequently divided longitudinally into several filaments, they are called flexible rays. The principal organ of motion is the tail; the dorsal and ventral fins apparently serve to balance the fish, and the pectorals to arrest its progress when required.

The Bones of fishes are of a less dense and compact nature than in the higher orders of animals, and always remain in an isolated state, similar to that of the embryo of the *Mammalia*. The skeleton may be divided into four chief parts—the vertebral column, the head, the respiratory apparatus, and the limbs. The vertebral column consists of vertebræ which are concave at each end and pierced in the middle; and when joined together the hollow space between each two is occupied by a gelatinous substance, which passes from one space to the next through the hole in each bone. This hole is usually very small, but in some of the Chondropterygians it is so large that the bodies of the vertebræ are mere rings. To the vertebræ are attached the ribs; in fact the ribs are the main support of all the other bones. The head varies more in form than in any other class of vertebrate animals. The same bones as those found in other oviparous animals are almost always traceable. We shall confine our observations to those which are most frequently referred to in technical descriptions.

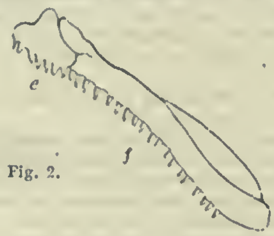


Fig. 2.

Fig. 3.

Fig. 2, upper jaw of a Trout: *e*, intermaxillary bone; *f*, maxillary bone.

Fig. 3, front view of the mouth of a Trout: *l*, the vomer furnished with teeth; *m m*, palatine bones also furnished with teeth; *n*, the tongue with recurved teeth.

The upper jaw consists of maxillary and intermaxillary bones; in the greater number of fishes the intermaxillary bones (*fig.* 1, *e*) con-

Fig. 1.

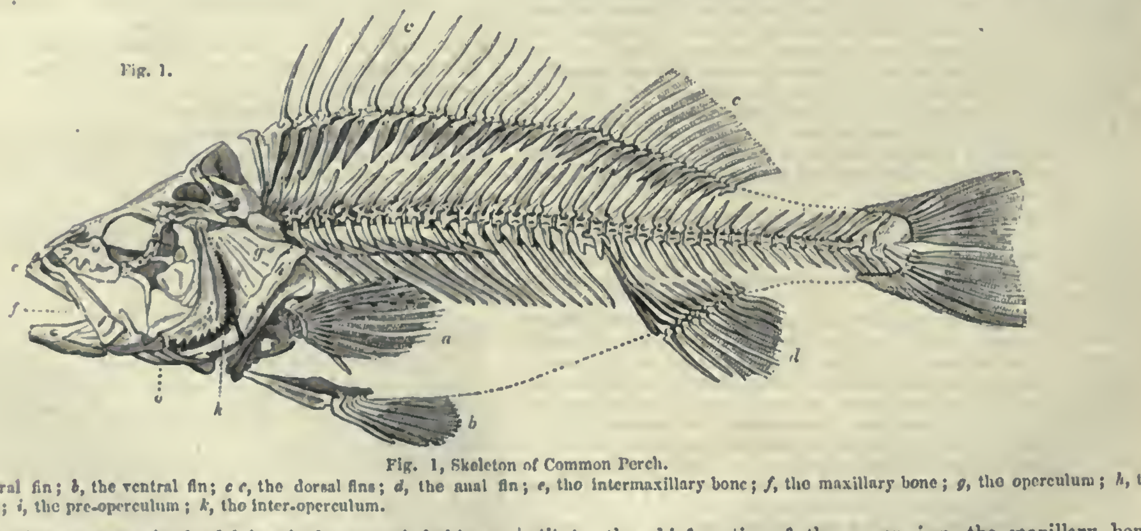


Fig. 1, Skeleton of Common Perch.

a, the pectoral fin; *b*, the ventral fin; *c c*, the dorsal fins; *d*, the anal fin; *e*, the intermaxillary bone; *f*, the maxillary bone; *g*, the operculum; *h*, the sub-operculum; *i*, the pre-operculum; *k*, the inter-operculum.

As the breathing apparatus in the fish is suited to aquatic habits, so likewise is every part of its structure. The body is generally of an elongate oval compressed form, covered with scales directed backwards, and furnished with fins; thus being beautifully adapted for swimming. Many fishes moreover have a bladder filled with air situated immediately beneath the spine, by the dilatation or compression of which their specific gravity is said to be varied. The thoracic part of the body is thrown forwards towards the head (so that fishes may be said to have no neck), and thus the hinder part of the body is more free and fitted for motion. The limbs are formed into fins,

stitute the chief portion of the upper jaw, the maxillary bones (*fig.* 1, *f*) being placed behind and parallel to them and articulated to the vomer. (*Fig.* 3, *l*.) In the salmon tribe and some other fishes however the intermaxillary bones (*fig.* 2, *e*) are smaller in proportion, and form a continuous line with the fore-part of the maxillary bones. (*Fig.* 2, *f*.) In the Chondropterygians the maxillary and intermaxillary bones are reduced to mere rudiments, their functions being performed by the bones analogous to the palatines, and sometimes by the vomer.

The lower jaw is generally composed of at least two bones on each side, the dental portion in front, and the articular portion behind.

The Palatines (*fig.* 3, *m m*) are extended longitudinally on each side, and form part of the roof of the mouth; they are often furnished with teeth.

The Opercular Bones.—The chief portion of the sides of the head behind the eye consists of the opercular bones: these are generally four in number, and are termed the operculum (*fig.* 1, *g*), the sub-operculum (*fig.* 1, *h*), the pre-operculum (*fig.* 1, *i*), and the inter-operculum (*fig.* 1, *k*). The first of these covers the gills.

The Branchiostegous Rays (*fig.* 1, *o*), which are often mentioned in descriptions, are situated under the opercular bones.

The Teeth in fishes are almost entirely osseous; they are usually of a simple spine-like form, and recurved at the tip. Teeth are found in almost every bone in the interior of the mouth; in the superior and inferior maxillary, and intermaxillary bones; likewise on the branchial arches, pharangeal bones (which are situated in the throat), and on the tongue. There is considerable variety in their structure, as will be found in the various descriptions of fishes found in other parts of this work.

The Scales are composed of two substances, one resembling horn in its texture, and the other of a harder and bone-like nature; they are generally attached to the skin by their anterior edge, and consist of numerous concentric laminæ (secreted by the skin), the smallest of which is first formed. Certain scales, forming a continuous series, in a slightly waved line from the head to the tail of the fish, are pierced in or near their centre, and furnished with a tube through which a slimy matter is poured, which serves to lubricate the body of the animal. This series of tubes forms a line visible on the sides of the body, and which is termed the lateral line.

The structure, form, and position of the scales of fishes are very variable, and have furnished M. Agassiz ('Recherches sur les Poissons Fossiles') with characters for a new classification of these animals.

As regards the senses, those of taste and touch appear to be but slightly developed in fishes. When we find the tongue thickly covered with teeth (as is often the case), and used as an organ of prehension, and when we consider the quick manner in which the food is swallowed, it would certainly appear that their sense of taste is very slight. The sense of touch is probably most developed in the cirrhi attached to the mouth of those fishes that have them. The long filaments with which the fins of some fishes are furnished also perhaps serve, through the sense of touch, to indicate the vicinity of weeds, or other objects in the water.

The eyes are differently placed in the various species of fishes, in accordance with their habits: for the most part they are placed laterally, and in some (those that live at the bottom of the water) we find them directed upwards. In some of the species of sharks (those of the genus *Zygæna*) they are situated at the end of an elongated lateral process on each side of the head.

The sight in fishes is acute; the range of vision however is probably somewhat limited. The eyes (which are furnished with a spherical lens) are generally large, but in some species they are very small, whilst others appear to be destitute of them.

Although fishes appear not to possess certain portions of the auditory apparatus, observed in animals of a higher grade, they nevertheless possess the sense of hearing.

There are reasons for the belief that the sense of smell in fishes is tolerably acute: their olfactory nerves are of large size, and disposed over a considerable extent of surface.

By far the greater number of fishes are of carnivorous habits; there are some however which feed upon vegetable substances, and we find the stomach modified accordingly as in other animals.

The sexes of fishes, if we except the sharks and rays, offer no very decided external characters by which they may be distinguished: as in the higher animals however, observes Mr. Yarrell, "the respiratory organs occupy more space in the males than in the females; and, on the other hand, the abdomen is larger in the females than in the males: the males may therefore be known from the females by their somewhat sharper or more pointed head, the greater length of the gill-cover, and the body from the dorsal fin downwards being not so deep compared with the whole length of the fish."

The sexual organs of fishes are in the generality of the species of a more simple nature than is observed in the higher orders of the *Vertebrata*, "consisting, as will be found, towards the season of producing their young, of two elongated oval lobes of roe, one on each side of the body, placed between the ribs and the intestinal canal; the lobes in the female, called hard roe, contain a very large number of roundish grains, called ova or eggs, which are inclosed in a delicate membranous tunic or bag, reaching to the side of the anal aperture, where an elongated fissure permits egress at the proper time. In the males, the lobes of roe are smaller than in the females, and have the appearance of two elongated masses of fat, which are called soft roe; they remain however firm till the actual season of spawning, when they become by degrees more and more fluid, and the whole is ultimately voided by small portions at a time under slight abdominal pressure.

"At the season for depositing the spawn, which varies with almost every genus, some species repair to the gravelly shallows of rivers, and others to the sandy bays of the sea. This movement is called by fishermen 'going to hill,' or 'roading;' other species resort to bunches of weeds. In many instances, when ready to deposit her spawn, a female is accompanied by two males, one on each side—a provision of nature which seems intended to secure the impregnation of the largest quantity of ova, and the range of the influence of the male fluid is enormously increased by diffusion in water. The adhesive nature of the surface of each egg supplies the means of attachment to any of the various substances near which it may happen to be left; and the time required for the appearance of the young fish is very variable, depending upon the species, the season, and its temperature. The young fish is first apparent as a line wound round the central vitelline portion of the egg, and ultimately escapes by rupturing the external capsule with its tail."

We now proceed to give an outline of Cuvier's classification of fishes, since it is that which is perhaps most generally adopted: it is nevertheless in many respects very artificial.

Fishes are divided by this author into two series, that of Ordinary Fishes, or *Ossei*, distinguished by having the skeleton bony; the osseous matter being disposed in fibres; the sutures of the cranium distinct; maxillary and intermaxillary bones, either one or both present: and that of the *Cartilaginei*, or *Chondropterygii*, distinguished by having the skeleton cartilaginous; the bones destitute of fibres; sutures of the cranium indistinct; maxillary and intermaxillary bones either wanting or rudimentary, their place being supplied by the palatine or vomer.

These two series are subdivided as follows:—

Series 1. *Ossei.*

Section 1. *Pectinibranchii.*

Order 1. *Acanthopterygii.*

Family *Percidæ.*
Loricati.
Sciænidæ.
Sparidæ.
Mænidæ.
Squamipinnati.
Scombridæ.
Tænioidæ.

Family *Theutyes.*
Pharyngiens labyrinthiformes.
Mugilidæ.
Gobiadæ.
Lophiadæ.
Labridæ.
Centriscidæ.

Order 2. *Malacopterygii.*

1\. *Abdominales.*

Family *Cyprinidæ.*
Esocidæ.
Siluridæ.
Salmonidæ.
Clupeidæ.

2\. *Subbrachiales.*

Family *Gadidæ.*
Pleuronectidæ.
Discoboli.
Echeneididæ.

Order 3. *Apodes.*
Murænidæ.

Section 2. *Plectognathi.*
Gymnodontidæ.
Sclerodermi.

Section 3. *Lophobranchii.*
Syngnathidæ.

Series 2. *Cartilaginei*, or *Chondropterygii.*

Order 1. *Eleutheropomi.*
Sturionidæ.
Chimæridæ.

Order 2. *Plagiostomi.*
Squalidæ.
Raiidæ.

Order 3. *Cyclostomi.*
Pteromyzidæ.

The characters of the two great series or sections into which fishes are divided, it has been shown, are taken from the nature of the skeleton. It remains for us now to make a few observations upon the minor subdivisions.

In the *Ossei*, or bony fishes, there are three sections. Those of the first, the *Pectinibranchii*, possess the following characters:—Branchiæ in continuous pectinated ridges, furnished with an opercular and branchiostegous membrane; jaws complete and free. Section 2, *Plectognathi*:—Branchiæ with the pectinations continuous; opercule and rays concealed beneath the skin; external aperture a simple cleft; jaws incomplete; maxillary firmly attached to the side of the intermaxillary, which alone forms the jaw; palatine arch united to the cranium by suture, and immovable. To this section belong the globe-fishes, file-fishes, &c. Section 3, *Lophobranchii*:—Branchiæ in small tufts; opercule large, confined on all sides by a membrane, with only a small hole for the external aperture; branchiostegous rays rudimentary; jaws complete and free. To this section belong the pipe-fishes, hippocampus, &c.

The two latter sections contain but a limited number of species: the *Pectinibranchii*, on the contrary, contain all the ordinary and typical fishes, and, as is seen in the foregoing list, is subdivided into three orders. The fishes of the first of these orders, the

Acanthopterygii, are distinguished by their having the anterior part of the dorsal, anal, and ventral fins furnished with simple spinous rays. [ACANTHOPTERYGII.] The perches, mullets, gurnards, mackerels, &c., belong to this order. In the second order, the *Malacopterygii*, all the fin-rays are flexible, with the exception sometimes of the first ray of the dorsal and pectoral fins. The three principal divisions of the *Malacopterygii* are founded either upon the position of certain fins or their absence. In the first division, the *Abdominales*, the ventral fins are situated far behind the pectorals; as in the carp, tench, bream, dace, roach, pike, salmon, &c. In the second group, the *Subbrachiales*, the ventral fins are situated immediately beneath the pectorals (or even a little before them); as we find them in the cod-fish, haddock, and whiting. The flat fishes also belong to this group—such as the plaice, flounder, turbot, sole, &c. To the third and last of these greater divisions of the *Malacopterygii* belong the eels, which have received the name *Apodes*, from their possessing no ventral fins.

In illustration of the three orders into which the *Cartilaginei* are divided, the Sturgeon will serve as an example of the first, or the *Eleutheropomi*. The *Plagiostomi* contain the Sharks and Rays; and the Lampreys and Myxines chiefly constitute the *Cyclostomi*.

Mr. M'Leay, to whom Natural History is so largely indebted for methods of classification, has given a new arrangement of fishes. The basis of this method is the quinarian system. He bases his classification on three generally admitted facts, which he holds to be incontestable. The first is the near approach of fishes to Batrachian *Amphibia*, which, with Swainson, he considers to be made by means of *Lophius* and *Malthe*. 2nd. The near approach of fishes to the Cetaceous *Mammalia*, the viviparous sharks constituting the connecting link. 3rd. "As the grand character of fishes as a class is their being the most imperfect of *Vertebrata*, the most typical of fishes ought therefore to be the most imperfect of them, namely, the furthest removed from the type of *Vertebrata*;" a position which many naturalists will be inclined to combat. He regards as examples of such fishes the *Cyclostomi*. Bearing the above 'fundamental facts' in mind, he constitutes the following primary divisions:—

Aberrant Group, *Ctenobranchii*. Gills pectinated.

1. *Plagiostomi*. Cartilaginous Fishes with fixed branchiæ, leading to *Mammalia*.
2. *Sturiones*. Cartilaginous Fishes with free branchiæ.
3. *Ostinopterygii*. Bony Fishes with free branchiæ, leading to *Amphibia*.

Normal Group, *Actenobranchii*. Fish breathing with gills, not pectinated.

4. *Lophobranchii*. Bony Fishes breathing by tufts arranged in pairs along the branchial arches.
5. *Cyclostomi*. Cartilaginous Fishes breathing by a series of cells.

Mr. M'Leay has not presented an analysis of the families and genera included under the above five orders, with the exception of those of the third, *Ostinopterygii*, a term by which he proposes to denominate the osseous fishes having pectinated gills. The following table of his subdivisions of this important order will convey to the naturalist a clear idea of his system.

Ostinopterygii.

A.

Aberrant Group, *Acanthopterygii*. Spines in the first dorsal fin hard.

Tribe 1, *Balistina*. Maxillary bones soldered to the intermaxillaries, and both to the palatine arch; opercula and gills concealed beneath the skin. Includes the families *Balistidæ, Ostraciontidæ, Cephalaspis, Orthagoriscidæ, Diodontidæ.*

Tribe 2, *Percina*. Bones of the jaws free and complete. Operculum distinct. Operculum or pre-operculum generally with dentated edges, or with spines. Includes *Chætodontidæ, Percidæ, Scorpænidæ, Cirrhitidæ, Sparidæ.*

Tribe 3, *Fistularina*. Bones of the jaws free and complete. Operculum distinct. Operculum and pre-operculum generally with smooth edges. *Scombridæ, Fistularidæ, Gobioidæ, Lophiidæ, Labridæ.*

B.

Normal Group, *Malacopterygii*. Spines in the dorsal fins soft.

Tribe 4, *Pleuronectina*. Ventral fins, when existing, inserted under the pectorals, and directly suspended to the bones of the shoulder. *Anguillidæ, Echeneidæ, Cyclopteridæ, Pleuronectidæ, Gadidæ.*

Tribe 5, *Abdominales*. Ventrals suspended behind the pectorals, and not attached to the bones of the shoulders. *Siluridæ, Cyprinidæ, Esocidæ, Clupeidæ, Salmonidæ.*

Geographical Distribution of Fishes.—This branch of ichthyology is beginning to attract the attention and research which the interest of the subject demands. Within the last twenty years the example of Yarrell has been followed in many countries, and valuable local monographs published, with excellent illustrations. In the north of Europe, besides the writings of Nilson and Eckstrom, the fishes of Denmark have been illustrated by Henrik Kroyer. Those of Belgium have been carefully examined by M. de Selys Longchamps. In that naturalist's 'Faune Belge' fifty-three fresh-water fishes and forty-one species inhabiting the sea are enumerated. Of the former, forty-three live only in fresh-water; six in fresh-water, but go to the mouths of rivers in winter; and four live in the sea, but migrate to the rivers in spring or summer. Of the sea-fishes thirty pass up the Scheldt as far as Antwerp. The fresh-water fishes of Central Europe have engaged the attention of Agassiz. Freyer has published an account of those inhabiting Carniola, amounting to thirty-two species. Italian ichthyology has been admirably illustrated by Prince Charles Lucien Bonaparte. In Asia the fishes of the Caspian have been described by Eichwald in his 'Fauna Caspio-Caucasica,' published in 1841. Those inhabiting the rivers of Syria have been enumerated by Heckel (1843) from the collections of Kotschy. Fifty-seven species inhabit the rivers Orontes and Euphrates, of which no fewer than forty-five are *Cyprinidæ*. Indian ichthyology has received valuable contributions from M'Clelland, whose papers have been chiefly published in the 'Calcutta Journal.' In Siebold's 'Fauna Japonica' (1842) are accounts and figures of Japanese fishes by Temminck and Schlegel. The most valuable contribution ever made to our knowledge of the ichthyology of Eastern Asia was communicated to the British Association at Cambridge in 1845, in the form of a report on the 'Ichthyology of China,' by Sir John Richardson. From his researches it would appear that the fishes of that region are not only very numerous as regards species, but also very valuable on account of the extensive fisheries there carried on. His remarks on their distribution are highly interesting. It would appear that chains of islands or coasts having an east and west extension determine the extent of the range of species and groups of species. For example, to take the intertropical zone of the ocean, we find a great number of fishes common to the Red Sea, the coasts of Madagascar, the Mauritius, the Indian Ocean, the south of China, the Philippines, the Malay Archipelago, the northern coast of Australia, and the whole extent of Polynesia, including the Sandwich Islands. As regards the generic forms of the fresh-water fishes, China agrees with the peninsula of India. Were the vast zone in question, embracing more than two-thirds of the circumference of the globe, to be suddenly elevated, we should find the remains of fishes similar everywhere throughout, the species which have a local distribution being few and unimportant. This result of Sir John Richardson's researches is of the highest importance when brought to bear on geological considerations. Sir John Richardson has also been engaged in the special investigation of the ichthyology of Australia, and his many valuable memoirs on that subject may be consulted in the 'Transactions of the Zoological Society,' and in the 'Annals of Natural History.' In Dieffenbach's 'Travels in New Zealand' (1843), the same indefatigable and philosophic zoologist has published, in conjunction with Dr. Gray, a list of the fishes of New Zealand. Ninety-two species are there enumerated. In Smith's 'Illustrations of the Zoology of South Africa,' figures and descriptions are given of the fishes of the Cape of Good Hope. The researches of Dr. Peters on the eastern coast of Africa, have made us acquainted with the ichthyology of that interesting region. With those of the northern part of Western Africa we have had ample information in the valuable memoirs of Lowe on the fishes of Madeira. ('Zoological Transactions and Proceedings.')

The labours of Jenyns on the fishes collected during Captain Fitzroy's voyages have contributed materially to our knowledge of the ichthyology of the southern extremity of South America, whilst that of Guyana has been illustrated by Sir Robert Schomburgk, in the 'Naturalists' Library.' De Kay's 'Zoology of New York' (1842) has made us acquainted in detail with the fishes of the United States. They amount, so far as known, to 440 species, distributed through 156 genera and 32 families. In the State of New York there are 126 *Acanthopterygii*, 115 *Malacopterygii*, 3 *Lophobranchii*, 18 *Plectognathi*, 3 species of sturgeon, and 27 cartilaginous fishes.

The distribution of fishes appears to be determined by the same laws which regulate that of other aquatic animals. Climate, composition of the element in which they live (whether salt, brackish, or fresh), and conformation of the sea or river bed, on which the depth of water depends, are the great regulating influences. The great distinctions of form and colour between fishes of tropical and those of temperate regions, evince the influence of climate; the fact of the fisheries for certain species commonly used for food being invariably conducted in deep water, whilst others can only be maintained among shallows, shows the influence of depth; the fact pointed out by Sir John Richardson that the seas, by ranges of land or reefs extending for great distances under the same climatal parallel, are peopled by the same species of fishes, is an instance of the action of the combined influences of climate and depth. The distinctness as to genera and species of the greater number of river and lake fish from those inhabiting the sea depends on the second of the three great influences enumerated—that of the composition of the element in which they live. Great depths cut off the range of species even when climatal conditions are similar. Hence the fishes of the coast of the United States are for the most part distinct from those on our own side of the Atlantic. Some fishes have very limited ranges in depth compared with others, and, generally speaking, it may be assumed that those having the greatest vertical range (that is, range in depth) have also the widest horizontal extension, a fact depending on the capacity of such species for living under a greater variety of conditions.

Barriers of land, as chains of mountains, determining the courses of rivers, are often the boundaries between two distinct specific assemblages of fresh-water fish, and in like manner a very narrow strip of land may divide two very distinct marine faunas. The distribution of marine vegetables, affecting the distribution of numerous marine *Invertebrata* which feed on those vegetables, and in their turn serve to furnish food for fishes, will materially affect the distribution of many species of the latter. So also will the presence of currents, and even the agency of man, assisting often unintentionally in the conveyance of ova from one country to another. Distant regions, presenting similar conditions, such as the arctic and antarctic seas, are inhabited by species representative but not identical, and presenting a general aspect very similar, depending on characters of form and colour, &c. It is probable also that the fishes inhabiting the greater depths of tropical seas resemble those of temperate climes, and that those of the latter in like manner approach arctic forms.

A brief glance at the range and distribution of the principal genera will best serve to illustrate the above positions.

The lowest and most anomalous of all the species of fishes, the *Branchiostoma*, is generally distributed through the seas of Europe. Only one species is known, yet we cannot but hope that the researches of the many active naturalists now occupied with the study of marine zoology will bring to light forms connecting the Lancelet with other genera. The *Myxine*, or Glutinous Hag, almost equally strange in form and structure, is confined to the most northern and most southern seas, and is replaced in the higher parts of the southern hemisphere by the equally curious and nearly allied genus *Heptatrema*. The Lampreys inhabit the fresh-waters of Europe and North America, but the species in each are quite distinct. *Lepidosiren*, the connecting link between fishes and reptiles, so dubious in organisation that its position is still disputed, is an inhabitant of the west of Africa, and a genus closely allied has been discovered by Dr. Peters on the eastern coast of the same continent.

The Rays and Sharks are universally distributed, but many of the genera and species are very local and apparently regulated in their range by climatal zones. The seas of Europe can boast of the greater number, though fortunately the most formidable of the species are exotics. The largest species, as the great *Silachus maximus*, the Basking Shark, are harmless, and have their favourite habitats in the temperate zone. Size among fishes does not appear to bear any relation to latitude. *Chimaera* is northern and southern, extending from the frigid zone. The *Sclerodermi* are for the most part southern and tropical, especially the curious forms of *Cestracion* and *Astracion*. *Monacanthus* inhabits the American and Chinese seas; *Triodon*, the Indian Ocean; *Tetrodon*, *Diodon*, and *Balistes* have wider ranges. The typical genus of Pipe-Fishes (*Syngnathus*), is cosmopolitan, and has a very wide geographical distribution. Six species are found in the British seas, two on the coast of the United States, and Mr. Jenyns has described new forms from Valparaiso, Tahiti, and Patagonia. *Hippocampus* is of the temperate zones of both hemispheres, and in the tropical seas is replaced by *Solenostoma* and *Pegasus*. The Sturgeons inhabit the Western European seas, the Caspian, the Black Sea, and the Mediterranean. Three species are North American.

Of the Eels, *Anguilla*, *Conger*, and *Muræna* are typical and cosmopolitan. *Gymnarchus* is Egyptian, *Gymnotus* (the Electrical Eel) South American, both inhabitants of fresh-water. The osseous flat fishes are very generally distributed; the largest species are inhabitants of northern seas. The Mediterranean boasts of many species of *Pleuronectes*. Species of Sole are found in both northern and southern hemispheres. The *Gadidæ* are inhabitants of northern and temperate seas, and certain species, as the Tusk, do not range farther southward than Norway and Scotland. *Lepidosteus*, one of the few remaining genera of Sauroid fishes, which appear to have played a most important part in the waters of ancient geological epochs, is confined to the rivers of America, and some allied forms to northern Africa. The herring tribe, *Clupeidæ*, has a wide distribution, and forms of the typical genus *Clupea* are found in the southern as well as in the northern hemisphere. The species however are locally distributed; thus the true Herring is unknown in the Mediterranean, where its place is taken by the Sardine, and the herrings of the South American coasts are quite distinct from those of the north. Even within very limited areas, as in that of the British seas, the species have peculiarities of distribution, as we see in the prevalence of the herring, properly so called, on the coasts of Scotland and in the Irish Sea, while it is replaced by the Pilchard on the south-west coasts of England and south of Ireland: the Whitebait is also a remarkable instance of local distribution. *Mormyra*, *Exocœtus*, and *Esox* are the typical forms of pikes; the first is North African; the flying fishes are oceanic and Mediterranean, and the pikes proper are inhabitants of the temperate zones. The restricted genus *Esox* is confined to fresh water.

The important family of *Salmonidæ* has its most valuable members in northern regions, some with a wide range, the same species of trout occurring in Lapland and in Switzerland. In North America the Trouts are represented by very similar but distinct species. M'Clelland has described a true salmon from India inhabiting the tributaries of the Oxus. This instance however does not affect the essentially temperate and subarctic character of the distribution of the *Salmonidæ*, for this Indian species was found at an elevation of 11,000 feet, where we must expect to find temperate forms prevail. Jenyns has made known a peculiar genus of *Salmonidæ*, which he has named *Aplochiton*, inhabiting the seas of the Falkland Islands and Tierra del Fuego. *Bajore* is a genus constituted by De Kay, and confined to the United States. The Argentines are Mediterranean, and *Sternoptyx* is oceanic.

Among the most characteristic fishes of the fresh waters of tropical countries are the *Siluridæ*, which abound in the regions of Central Asia, where almost all the species of the typical genus *Silurus* occur. A single offset finds its way to Europe. *Pimelodus* and *Callichthys* are American genera of this family; the electrical *Malapterurus*, North African; *Loricaria*, South American. Equally interesting and well marked in distribution is the fresh-water family *Cyprinidæ*. The true Carps are characteristic of the Old World; *Catastoma* and *Anableps* of the New World.

Of the Acanthopterygious Fishes the genera *Centriscus* and *Fistularia* are, with the exception of a single Mediterranean species, tropical. The genera of *Labridæ* have well-marked provinces. Thus the numerous species of *Scarus* are grouped together in tropical seas, being replaced in temperate regions by *Labrus* and *Crenilabrus*. There are offsets however of each. The frog-fishes *Lophius* and *Chironectes* are chiefly represented in Africa and South America. A single *Lophius* is a native of European seas. De Kay enumerates seven *Lophiadæ* as inhabitants of the United States, and Richardson has described some Australian species. The Goby tribe prevails in Europe and Asia. Some of the species of *Gobius* are remarkable for the depth at which they live. The Blennies are truly European, with very few exceptions. The Gunnels are mostly of northern seas. Some species of the Goby tribe inhabit fresh water, as the genus *Tænioides*, which is found in marshes in India. *Comepturus* lives in Lake Baïkal, and one or two species of *Gobius* proper live in rivers.

The *Mugiloidæ* are very generally extended. They have been said to be absent from North America, but this is incorrect, four species of Mugil inhabiting the United States. *Atherina* is also a cosmopolitan genus.

The Labyrinthiform Pharyngeans are essentially tropical, being all natives of the eastern regions of Asia. Their organisation is peculiarly adapted to their climatal range. The *Teuthyes* are fishes of warm climates, and many species inhabit the Australasian seas. The Mackerel tribe includes a number of genera, which have very various areas of distribution. Among them the Dolphins (*Coryphæna*) are Mediterranean and oceanic; the Dories (*Zeus*) mostly European; *Vomer*, exotic; *Notacanthus*, arctic; *Lichia*, Mediterranean. *Scomber* and the allied typical genera of the tribe are mostly cosmopolitan. The Chetodons are essentially equatorial.

The family of *Sparoideæ* gives the most prominent feature to the ichthyology of the Mediterranean and seas of Southern Europe. *Pagrus* has a wide range, but chiefly through warm regions. The *Sciænoideæ*, very numerous in species, are mostly equatorial. The important family of *Triglidæ*, of which the Gurnard is the type, has a very extensive distribution. The true Gurnards are mostly European; *Scorpæna* ranges from Europe to Australia. *Platycephalus* is peculiarly Indian. *Sebastes* is a genus of the Old World, with one or two exceptions.

The *Percidæ*, chief of the Acanthopterygious families, is partly composed of marine and partly of fresh-water genera. The genus *Perca* is characteristic of the northern temperate zone. *Mesoprion*, *Diacope*, *Plectropomus*, and *Serranus* are cosmopolitan. *Mullus* and *Paralepis* are European genera. *Holocentris*, *Myripristis*, *Priacanthus*, and *Dules* are represented in both hemispheres. *Ambassis* is an Indian fresh-water genus. *Percophis*, *Pinguipes*, *Centrarchus*, and *Pomotis* are American. *Beryx*, *Trachichtes*, *Helotes*, *Pelotes*, and *Chironema* are Australian.

Fossil Fishes.—In the study of extinct fishes the structure of the scales is of first importance, and according to their particular characters the whole of the fossil species have been divided. M. Agassiz makes four orders, each of which contains fishes having a cartilaginous skeleton; in each there are genera the species of which have spinous rays in the dorsal fin, and other genera where all the rays of the dorsal fin are soft. There are likewise in each order both apodal and abdominal genera; and in two of the orders there are in addition certain species in which the ventral fins are thoracic, and others in which they are jugular. These four orders are named by M. Agassiz *Placoides*, *Ganoides*, *Ctenoides*, and *Cycloides*.

The name *Placoides* (from πλαξ, a plate or slab) was applied to the first of these orders on account of the irregularity which the solid tegumentary parts present. They consist of masses of enamel, which are often of considerable size, and sometimes minute. To this family belong the *Cestracionites*, of which there is but one existing genus (the genus *Cestracion*), the *Squalidæ*, *Raidæ*, and *Cyclostomi*.

The second order, *Ganoides* (from γανὸς, splendour), are distinguished by the angular form of the scales; these are composed of layers of corneous or osseous substances, disposed one upon the other and covered by a thick coat of enamel, and consequently resemble teeth in their structure. This order contains the following families:—*Lepidoides*, all the species of which are fossil; the *Sauroides*, which are also fossil, with the exception of two genera, *Lepisosteus* and *Polypterus;* the *Pycnodontes*, likewise fossil; the *Sclerodermi*, *Gymnodontes*, *Lophobranchii*, *Goniodontes*, *Siluridæ*, and *Sturiones*.

In the third order, *Ctenoides* (from κτένος, a comb), the scales consist of laminæ whose posterior and free margin is pectinated. A structure very evident in the Chætodons and Flat-Fishes (*Pleuronectidæ*), which M. Agassiz thinks ought to be placed close together. In this order are also arranged the *Percidæ*, *Polyacanthes*, *Sciænidæ*, *Sparidæ*, *Scorpænidæ*, and *Aulostomes*.

Order four, *Cycloides* (from κύκλος, a circle). The families which belong to this order have the scales formed of simple laminæ, with the posterior margin smooth. The scales of the lateral line are formed like the others, but instead of flat laminæ they consist of ducts placed one within the other, of which the retiring portion, which is applied against the disc of the scale, forms the tube through which flows the mucous secretion which covers the fish. This tube is sometimes bifurcate, or even ramified. The *Labridæ*, *Mugilidæ*, *Atherinæ*, *Scombridæ*, *Gadidæ*, *Gobiadæ*, *Murænidæ*, *Lucioides*, *Salmonidæ*, *Clupeidæ*, and *Cyprinidæ* belong to this tribe.

In his work entitled 'Recherches sur les Poissons Fossiles' M. Agassiz has employed this arrangement in his description of Fossil Fishes. At the request of the British Association for the Advancement of Science, M. Agassiz has drawn up a list of fishes occurring in the British strata, and we subjoin an abstract of this report. The geological classification is that developed in the articles PALÆOZOIC SERIES and SALIFEROUS SYSTEM.

TABLE I.—*General Distribution of the Orders of Fossil Fishes.*

	Placoid.	Ganoid.	Ctenoid.	Cycloid.
Cainozoic Strata	•	•	•	•
Mesozoic Strata	•	•	•	•
Palæozoic Strata	•	•		

Hence it appears that the two orders of Ctenoid and Cycloid Fishes, which are the most abundant in existing nature, have no representatives yet discovered in the Palæozoic Strata.

If we divide the two groups of Mesozoic and Palæozoic Strata into their constituent parts we shall have additional results.

TABLE II.—*Distribution of the Orders of Fossil Fishes in Mesozoic and Palæozoic Strata.*

	Placoid.	Ganoid.	Ctenoid.	Cycloid.
MESOZOIC:				
Upper	•	•	•	•
Middle	•	•		
Lower	•	•		
PALÆOZOIC:				
Upper	•	•		
Middle	•	•		
Lower	•			

Hence it would appear that the Placoid Fishes (*Onchus*, &c.) are, geologically speaking, the most ancient of the finny races; that the Ganoid Fishes, *Holoptychius*, &c., begin in the middle Palæozoic series, and the Ctenoid and Cycloid only in the upper Mesozoic (Cretaceous) group. It is however very possible that this last statement may be modified by further research in the Oolites. At present the distribution of Ctenoid and Cycloid Fishes in the Chalk is thought to favour the notion of the almost Cainozoic character of that deposit.

In the next four tables (Tables III., IV., V., and VI.) we give the geological distribution of the several families (some are merely provisional) under which M. Agassiz has ranged the British Fossil Placoid Fishes.

TABLE III.—*Distribution of the Families of Placoid Fishes.*

	Ichthyodorulites.	Cestraciontes.	Hybodontes.	Squalides.	Raies.	Chimerides.	
CAINOZOIC:							
Upper . .	•	—	—	•	•	—	
Middle . .	—	—	—	—	—	—	
Lower . .	•	—	—	•	•	•	Period of greatest abundance.
MESOZOIC:							
Upper . . .	•	•	—	•	—	•	
Middle . .	•	•	•	•	•	•	
Lower . .	•	—	—	—	—	—	
PALÆOZOIC:							
Upper . .	•	•	•	•	—	—	
Middle . .	•	•	—	—	—	—	
Lower . .	•	—	—	—	—	—	

Hence the most prolific periods for Placoid Fishes seem to be the upper Palæozoic, the middle and upper Mesozoic, and the lower Cainozoic strata.

TABLE IV.—*Distribution of the Families of Ganoid Fishes.*

	Lepidioides.	Sauroides.	Cœlacanthes.	Pycnodontes.	Acipenserides.	Sclerodermes.	
CAINOZOIC:							
Upper . .	—	—	—	—	—	—	
Middle . .	—	—	—	—	—	—	
Lower . .	—	—	—	•	•	—	
MESOZOIC:							
Upper . .	•	•	•	•	—	•	Period of abundance.
Middle . .	•	•	•	•	•	—	
Lower . .	•	•					
PALÆOZOIC:							
Upper . .	•	•	•	—	—	—	
Middle . .	•	•	•	—	—	—	
Lower . .	—	—	—	—	—	—	

The Ganoid Fishes (singular forms however) begin to abound in the middle Palæozoic series, and become rare above the lower Cainozoic series. They are also rare in existing nature. M. Agassiz once included the *Glyptocephalus* of Sheppey among the Ganoids, but in his later catalogue he has joined it to the Cycloids.

TABLE V.—*Distribution of the Families of Ctenoid Fishes.*

	Percoides.	Sparoides.	Teuthies.	Chetodontes.
CAINOZOIC:				
Upper	—	—	—	•
Middle	—	—	—	—
Lower	•	•	•	—
MESOZOIC:				
Upper	•	—	—	—
Middle	—	—	—	—
Lower	—	—	—	—
PALÆOZOIC:				
Upper	—	—	—	—
Middle	—	—	—	—
Lower	—	—	—	—

The account of the Ctenoid Fishes in the lower Cainozoic Strata is from the report of M. Agassiz to the British Association in 1844.

TABLE VI.—*Distribution of the Families of Cycloid Fishes.*

	Acanthopterygians.					Malacopterygians.						
	Scomberoides.	Xiphioides.	Sphyrænoides.	Labroides.	Blennioid	Scomberesoces.	Clupeides.	Characins.	Gadoides.	Anguilliformes.	Doubtful.	Undetermined.
CAINOZOIC:												
Upper . .	—	—	—	—	—	—	—	—	—	—	—	—
Middle . .	—	—	—	—	—	—	—	—	—	—	—	—
Lower . .	•	•	•	•	•	•	•	•	•	•	•	•
MESOZOIC:												
Upper . . .	—	•	—	—	—	•	—	—	—	—	—	•
Middle . .	—	—	—	—	—	—	—	—	—	—	—	—
Lower . . .	—	—	—	—	—	—	—	—	—	—	—	—
PALÆOZOIC:												
Upper . .	—	—	—	—	—	—	—	—	—	—	—	—
Middle . . .	—	—	—	—	—	—	—	—	—	—	—	—
Lower . .	—	—	—	—	—	—	—	—	—	—	—	—

To complete this view of the geological distribution of Fossil Fishes we append an abstract of the catalogues of M. Agassiz, which have been already referred to.

Silurian System.

PLACOID FISHES.

Ichthyodorulites.

Onchus, 2 species.

Family unknown.

Thelodus, 1 species.
Sclerodus, 1 species.
Plectrodus, 2 species.
Sphagodus, 1 species.
Pterygotus, 1 species. (This is probably a Crustacean.)

Devonian System.

PLACOID FISHES.

Ichthyodorulites.

Onchus, 2 species.
Parexus, 1 species.
Ctenacanthus, 1 species.
Ptychacanthus, 1 specie
Clematius, 1 species

Cestraciontes.

Ctenoptychius, 1 species.

GANOID FISHES.

Lepidoides.

Dipterus, 1 species.
Osteolepis, 4 species.
Acanthodes, 1 species.
Diplacanthus, 4 species.
Cheiracanthus, 3 species.
Cheirolepis, 3 species.
Cephalaspis, 4 species.
Pterichthys, 8 species.
Coccosteus, 3 species.
Chelonichthys, 2 species.

Sauroides.

Diplopterus, 3 species.
Platygnathus, 3 species.
Dendrodus, 3 species.
Lamnodus, 2 species.
Cricodus, 1 species.
Megalichthys, 1 species.

Cœlacanthes.

Holoptychius, 5 species.
Glyptosteus, 2 species.
Phyllolepis, 1 species.
Glyptolepis, 2 species.

Carboniferous System.

PLACOID FISHES.

Ichthyodorulites.

Onchus, 6 species.
Ctenacanthus, 6 species.
Ptychacanthus, 1 species.
Sphenacanthus, 1 species.
Asteroptychius, 2 species.
Physonemus, 1 species.
Gyracanthus, 4 species.
Oracanthus, 4 species.
Leptacanthus, 2 species.
Tristychius, 1 species.
Cladacanthus, 1 species.
Cricacanthus, 1 species.
Orthacanthus, 1 species.
Pleuracanthus, 3 species.

Cestraciontes.

Orodus, 2 species.
Helodus, 9 species.
Chomatodus, 3 species.

GANOID FISHES.

Lepidoides.

Acanthodes, 1 species.
Amblypterus, 3 species.
Palæoniscus, 6 species.
Eurynotus, 2 species.
Platysomus, 1 species.
Plectrolepis, 1 species.

Sauroides.

Megalichthys, 2 species.
Diplopterus, 2 species.
Pygopterus, 3 species.
Acrolepis, 1 species.
Orognathus, 1 species.
Graptolepis, 1 species.
Pododus, 1 species.

Cœlacanthes.

Cœlacanthus, 2 species.
Holoptychius, 8 species.
Hoplopygus, 1 species.
Uronemus, 1 species.
Phyllolepis, 1 species.

Permian System.

PLACOID FISHES.

Ichthyodorulites.

Gyropristis, 1 species.

GANOID FISHES.

Lepidoides.

Palæoniscus, 5 species.
Platysomus, 3 species.

Sauroides.

Acrolepis, 1 species.
Pygopterus, 2 species.

Cœlacanthes.

Cœlacanthus, 1 species.

Triassic System.

PLACOID FISHES.

Ichthyodorulites.

Hybodus, 1 species.
Nemacanthus, 2 species.
Leiacanthus, 1 species.

Cestraciontes.

Acrodus, 1 species.
Ceratodus, 10 species.

Hybodontes.

Hybodus, 1 species.

GANOID FISHES.

Lepidoides.

Gyrolepis, 3 species.
Palæoniscus, 1 species.

Sauroides.

Saurichthys, 3 species.
(N.B. Agassiz includes the Bone-bed at the base of the Lias in the Triassic System.)

Oolitic System.

PLACOID FISHES.

Ichthyodorulites.

Leptacanthus, 3 species.
Nemacanthus, 1 species.
Myriacanthus, 3 species.
Asteracanthus, 5 species.
Hybodus, 13 species.
Pristacanthus, 1 species.
Cochliodus, 5 species.
Psammodus, 4 species.
Pœcilodus, 6 species.
Pleurodus, 2 species.
Ctenoptychius, 8 species.
Ctenodus, 3 species.
Petalodus, 8 species.

Hybodontes.

Cladodus, 8 species.
Diplodus, 2 species.

Squalides.

Carcharopsis, 1 species.
Cyclarthrus, 1 species.
Squaloraia, 1 species.

Chimerides.

Chimæra, 11 species. (This includes several generic groups of Egerton.)

GANOID FISHES.

Lepidoides.

Dapedius, 7 species.
Tetragonolepis, 14 species.
Centrolepis, 1 species.
Amblyurus, 1 species.
Semionotus, 1 species.
Lepidotus, 13 species.
Pholidophorus, 12 species.
Nothosomus, 1 species.
Ophiopsis, 2 species.

Sauroides.

Eugnathus, 13 species.
Ptycholepis, 1 species.
Conodus, 1 species.
Pachycormus, 9 species.
Caturus, 3 species.
Thrissonotus, 1 species.
Amblysemius, 1 species.
Sauropsis, 2 species.
Leptolepis, 4 species.
Saurostomus, 1 species.
Aspidorhynchus, 2 species.
Belonostomus, 3 species.
Macrosemius, 1 species.

Cœlacanthes.

Ctenolepis, 1 species.
Gyrosteus, 1 species.

Pycnodontes.

Gyrodus, 6 species.
Sphærodus, 3 species.
Gyronchus, 1 species.
Microdon, 2 species.
Periodus, 1 species.
Pycnodus, 13 species.

Acipenserides.

Chondrosteus, 1 species.

Cretaceous System.

PLACOID FISHES.

Ichthyodorulites.

Ptychodus, 5 species.
Hybodus, 1 species.
Chimæra, 1 species.
Spinax, 1 species.

Cestraciontes.

Ptychodus, 5 species.
Acrodus, 1 species.
Strophodus, 2 species.

Squalides.

Scylliodus, 1 species.
Notidanus, 2 species.
Corax, 1 species.
Otodus, 1 species.
Oxyrhina, 1 species.
Lamna, 3 species.

Chimerides.

Chimæra, 5 species.

GANOID FISHES.

Lepidoides.

Lepidotus, 1 species.

Sauroides.

Caturus, 1 species.

Cœlacanthes.

Macropoma, 2 species.

Pycnodontes.

Acrotemnus, 1 species.
Gyrodus, 4 species.
Pycnodus, 5 species.
Sphærodus, 1 species.

Sclerodermes.

Dercetis, 1 species.

Cestraciontes.

Acrodus, 8 species.
Ceratodus, 1 species.
Strophodus, 6 species.

Hybodontes.

Hybodus, 10 species.
Sphenonchus, 3 species.

Squalides.

Thyellina, 1 species.
Oxyrhina, 1 species.

Raies.

Arthropterus, 1 species.

CTENOID FISHES.

Percoides.

Beryx, 3 species.

CYCLOID FISHES.

Hypsodon, 1 species.
Enchodus, 1 species.
Saurocephalus, 2 species.
Saurodon, 1 species.
Tetrapterus, 1 species.
Acrognathus, 1 species.
Aulolepis, 1 species.
Osmeroides, 2 species.

Tertiary System.

PLACOID FISHES.

Raies.

Myliobates, 16 species.
Zygobates, 1 species (Crag.).
Aetobates, 2 species.
Pristis, 3 species.
Raia, 1 species.

Squalides.

Notidanus, 1 species.
Glyphis, 1 species.
Carcharodon, 2 species.
Otodus, 2 species.
Lamna, 1 species (Crag.).

Chimerides.

Elasmodus, 1 species.
Edaphodon, 3 species.
Passalodon, 1 species.
Psaliodus, 1 species.

GANOID FISHES.

Pycnodontes.

Pycnodus, 1 species.
Periodus, 1 species.
Gyrodus, 1 species.
Phyllodus, 6 species.
Pisodus, 1 species.

Acipenserides.

Acipenser, 1 species.

CTENOID FISHES.

Percoides.

Myripristis, 1 species.
Cœloperca, 1 species.
Eurygnathus, 1 species.
Podocephalus, 1 species.
Synophrys, 1 species.
Brachygnathus, 1 species.
Percostoma, 1 species.

Sparoides.

Sciænurus, 2 species.

Teuthies.

Ptychocephalus, 1 species.
Pomaphractus, 1 species.
Calopomus, 1 species.

CYCLOID (ACANTHOPTERYGIOUS) FISHES.

Scomberoides.

Cybium, 1 species.
Cœlopoma, 2 species.
Bothrosteus, 3 species.
Phalacrus, 1 species.
Rhonchus, 1 species.
Echenus, 1 species.
Scombrinus, 1 species.
Cœlocephalus, 1 species.
Naupygus, 1 species.

Xiphioides.

Tetrapterus, 1 species.
Cœlorhynchus, 2 species.
Phasganus, 1 species.
Acestrus, 1 species.

Sphyrænoides.

Sphyrænodus, 2 species.

Labroides.

Auchenilabrus, 1 species.

Blennioides.

Laparus, 1 species.

CYCLOID (MALACOPTERYGIOUS) FISHES.

Scomberesoces.

Hypsodon, 2 species.
Labrophagus, 1 species.

Clupeides.

Halecopsis, 1 species.
Megalops, 1 species.

Characins.

Brychetus, 1 species.

Gadoides.

Rhinocephalus, 1 species.
Merlinus, 1 species.
Ampheristus, 1 species.
Goniognathus, 1 species.

Anguilliformes.

Rhynchorhinus, 1 species.

(Doubtful Family.)

Pachycephalus, 1 species.
Rhipidolepis, 1 species.
Glyptocephalus, 1 species.
Gadopsis, 1 species.
Loxostomus, 1 species.

Note.—In the preceding Lists the French titles of the families are retained, as given by Agassiz.

The following description of some of these fishes, from Professor Ansted's picturesque 'Sketches of Creation,' will give the general reader an idea of the forms assumed by some of the extinct fishes of our own Island:—

"The tribe of existing Placoid Fishes most resembling those whose remains are found fossil, is that of which the Sharks are the well-known representatives. These powerful and rapacious animals, which are at this day the tyrants of the deep, seem to have been, when first introduced, of small size, and were accompanied by some few species of the next or Ganoid order. Only nine species of these Shark-like monsters have yet been determined with certainty from the Silurian and Devonian rocks, and of these two only are from the former. It is chiefly the Ganoid Fishes whose remains are handed down to us in the Old Red-Sandstone and other rocks of that period. Sixty distinct species of these fishes have been mentioned; and almost all of them are known from British specimens. Most of them are remarkable for exhibiting strange peculiarities of shape, approximating them in some instances to the structure of the lower orders of animals, combined with some apparent affinities to the class of reptiles. The most remarkable group of these fishes contains several genera, three of which will require special notice: they are the *Cephalaspis*, or Buckler-Headed; the *Pterichthys*, or Wing-Fish; and the *Coccosteus*, so called from the berry-like tubercles with which its bony scales are covered.

"The most extraordinary part of the first of these fishes, the Buckler-Headed, is the head, from which its name is taken. This has been compared to the crescent-shaped blade of a saddler's cutting-knife, the body forming the handle. It is extremely broad and flat, extending on each side considerably beyond the body, and the bones appear to have been firmly soldered together, so as to form one shield, the whole head being thus apparently covered by a single plate of enamelled bone, and when seen detached from the body, hardly to be distinguished from the head of a trilobite. The body, compared with this singular head, appears extremely diminutive; the back is arched, and gradually recedes in elevation towards the tail, which is of moderate length; the fins are few in number, and not very powerful, but appear to have possessed a bony ray in front, the rest of the fin being more fibrous. The whole body was covered with scales, which varied in shape in different parts, and seem to have been disposed in series. This fish never seems to have attained a large size, the best preserved specimen having only a length of seven inches, with a breadth of three inches between the points of the crescent-shaped buckler. It has been supposed by Professor Agassiz that the singular shape of the head served as a defence to this animal in case of attack; and one can readily imagine that the soft substance of the Orthoceratites, probably the largest and most formidable of its enemies, would be injured by any attempt to swallow so singular and knife-like an animal as the one before us. Like many and indeed most of the species belonging to the Ganoid order of fishes, and common in the older rocks, the bones of the head and the scales of this strange monster were composed internally of a comparatively soft bone, but each was coated with a thick and solid plate of enamel of extreme hardness, and almost incapable of injury by any ordinary amount of violence. The detached scales, the buckler head, and sometimes the complete outline of the animal have thus been able to resist destruction, and are found in sandy rocks composed of such coarse fragments that their accumulation would seem to have been accompanied with violence sufficient to have crushed to powder almost any remains of organised matter, and from which indeed we never obtain any fragments of shells or other easily-injured substances. The remains of this fish have been found in Herefordshire and many parts of Wales, as well as in Scotland, and lately also in Russia; but the animal was strictly confined to the period of the Old Red-Sandstone, though it is not easy to guess what may have been its habits, in what depth of water it preferred to live, or in what way it obtained its food.

"The *Pterichthys* is even more strikingly different from any existing species of animal than the singular monster we have just been describing. Reverting to the graphic description of Mr. Miller, we find it compared to the figure of a man rudely drawn, the head cut off by the shoulders; the arms spread out at full length as in the attitude of swimming; the body rather long than otherwise, and narrowing from the chest downwards; one of the legs cut away at the hip-joint, and the other, as if to preserve the balance, placed directly under the centre of the figure, which it seems to support. Something of this appearance is indeed presented in the fossil remains of these creatures, once the tenants of the sea in our own latitude; but we are now able to describe with more minuteness, if not so vividly, the real nature of the animal. It was of small size, not more than a few inches or a foot in length; its head and body were defended by strong plates of bone, coated with enamel; and its shape and proportions were singularly unlike those of ordinary fishes, the head being small, and the body much flattened but swelling out immediately at the junction of the head and neck, and gradually tapering thence towards the tail. From the junction of the head and body there extended that pair of singular paddles, or wings, from which the genus has been named, and which have been supposed to answer the same purpose as the horns of the crescent-shaped shield of the *Cephalaspis*, and to defend the animal from the attacks of its soft-mouthed enemies. Besides those paddles, which were hard and pointed, and nearly as long as the body, at least some species of *Pterichthys* seem to have been provided with another smaller pair extending from the part where the body is attached to the tail; and it is thought that this second pair of wings may be the remains of anal fins, the other pair representing the pectoral fins. The body, like the head, was certainly covered on the upper side by hard plates, accurately fitting one another, but the lower part both of the head and body was probably defended by tough skin, capable of distension, and enabling the creature to swallow prey of large size. The position of the mouth is not known with certainty, but it may have been formed by a transverse slit, covered by thick fleshy lips, situated round the edge of the plate which defended the head; this position, and the absence of teeth, readily accounting for the difficulty there is in discovering remains of it in imperfect specimens. The eyes and the apertures of the nostrils were probably extremely small, and placed on the edge of the broad plate, the only indication of the head hitherto met with. The tail was not long, but seems to have been thick and conical, and covered with scales overlapping each other like the tiles on the roof of a house.

"The departure from the general form of most fishes in this animal is so remarkable, that, when first discovered, it was looked upon by some naturalists as an insect, by others as a crustacean, and by others again it was thought to be connected with reptiles, owing to the singular resemblance of one small species to the shell of a tortoise. Strange as it undoubtedly is however in all respects, this genus forms one of an extinct family of fishes, and it is allied to the other genera of its class by the genus *Coccosteus*, which at one time was thought still more anomalous. The *Coccosteus* is entirely without the wing-like projections which characterise the *Pterichthys*, and while when seen, as in ordinary specimens, lying on its back and crushed, it appears to bear no resemblance to any fish or other animal, either recent or extinct; it was not in reality much unlike many well-known fishes in its general outline, although so oddly coated with large broad plates, which were studded with enamel instead of scales.

"The head of the *Coccosteus* was large, broad, and high, nearly circular in shape, covered by several plates, and attached to the body by a very small articulating surface, resembling in this the insects, and departing widely from the fishes. The jaws are large in proportion, and armed with very strong pointed teeth; the mouth opened as in the cod and other well-known fishes, and no doubt rendered the animal sufficiently formidable; and the lower part of the head seems to have been covered with a tough membrane capable of distension, and enabling the animal to swallow very large bodies; the upper part of the body was chiefly covered by one large plate, and the lower part by four plates of rather curious shape. The tail was large, and much longer than the body, and was provided with two small fins. The detached plates, more especially those which covered the body, are frequently found fossil in certain localities of the Old Red-Sandstone. The fishes just described form together one of several groups characteristic of the period we are now considering. But another group also, containing four genera, is worthy of notice, as contrasting strongly with the *Cephalaspides* (as the former are called), and instead of being clothed with large plates, these are recognised by the extremely minute scales with which the fish belonging to it are covered. These scales give to the skin an appearance very strikingly resembling shagreen.

"The size of the fishes thus brought together is generally small, and their shape is squat and awkward, the head being large, and the body dwindling away to a very small tail. They have however large teeth, and must have been powerful if not very rapid fishes. Their fins offer some peculiarities, being formed of a multitude of delicate-jointed rays, generally terminated by one very powerful ray or spine, sometimes simply planted in the flesh, sometimes articulated to bone. Both this group and the former are entirely confined to the first epoch, and almost entirely to the particular period of the Old Red-Sandstone.

"Another group of these ancient fishes (Dipterians) is remarkable for the great magnitude to which the fins were developed, and the fact that in all of them the fins on the back and below the tail are double. The jaws of these animals were provided with sharp pointed teeth; the head inclosed as if in a box of cartilage coated with enamel, and the scales of the body are in some species so large as not to have required more than half a dozen to reach from head to tail. This however was by no means a general character; and the presence of prominent spines supporting and defending the fins is probably more essential. It is probable that almost, if not all, the fishes of this family of Dipterians were more rapid swimmers and more voracious than those of the former two families. They are all however of small size. Besides these there is another family, chiefly developed in the latter part of the period, and attaining a larger size. One of the members of this group has been named *Holoptychius*, and is confined to the Devonian period. Its head was small compared with the size of the body, whose proportions were so robust, and its covering of large, rounded, deeply-wrinkled scales, on so grand a scale as almost to deserve being called gigantic. The actual measurement of the body in one complete specimen is 30 inches by upwards of 12 inches. The jaws were of bone coated with naked enamel; a row of thickly-set pointed teeth fringed the lips, and within this row another, whose bulk was at least twenty times as great. The other genus, *Megalichthys*, was perhaps more strikingly characteristic of the next succeeding period, during which the Carboniferous Limestone and Coal were being deposited; and it may therefore be as well to postpone for the present any description of it."

(Owen, *Lectures on Comparative Anatomy*, vol. ii.; Yarrell, *British Fishes;* Agassiz, *Recherches sur les Poissons Fossiles;* Agassiz, *Report on the Fossil Fish of the Devonian System; Transactions of British Association*, 1842; Richardson, *Report on the present State of the Ichthyology of New Zealand*, ib.; Agassiz, *Synoptical Table of British Fossil Fishes*, ib. 1843; Agassiz, *Sur les Poissons Fossiles de l'Argile de Londres*, ib. 1844.)

FISH-LICE. [CALIGUS.]

FISHES, FOSSIL. [FISH.]

FISHING-FROG. [LOPHIUS.]

FISSIROSTRES, the Swallow Tribe of Birds, distinguished by a very broad bill with a very wide gape, and small and feeble feet. They belong to the order *Insessores*, or Perchers, and take their food on the wing. [HIRUNDINIDÆ; INSESSORES.]

FISSURELLIDÆ, a family of Prosobranchiate Gasteropodous *Mollusca*. This family constitutes a very natural transition from the Limpets [PATELLIDÆ], to the completely spiral univalve shells. All the species of this family are remarkable for some solution of continuity in the shell, either a perforation or a slit in the region of the vent. The form of their shells is more or less conical, with indications of a rudimentary spire at the apex, which often disappears with increasing age. The animals have well-developed heads, with short muzzles and subulate tentacles, at the external bases of which are the eyes placed on rudimentary pedicles.

This family embraces the genera *Fissurella, Emarginula, Puncturella, Parmophorus*, and *Rimula*.

The *Fissurellæ*, which Cuvier places among the Scutibranches, his seventh order of Gasteropods, have a large fleshy disc or foot beneath the belly, like the *Patellæ*, and a conical shell fixed upon the middle of the back, but not always entirely covering it, for this shell is pierced at its summit with a small aperture, generally oval, which, according to Cuvier, serves at the same time as a passage for the water necessary to respiration and as an outlet for the excrements. This aperture penetrates into the cavity of the branchiæ situated on the fore part of the back, and in the bottom of which the vent discharges itself. This cavity is, besides, widely opened above the head. There is on each side, symmetrically disposed, a pectinated branchia or gill. The tentacula are conical, at the external bases of which the eyes are situated. The sides of the foot are fringed with filaments. Dr. Gray says, "In the young state of the *Fissurellæ*, the hole by which the fæces pass out of the shell is placed a little in front of its recurved and spiral apex; in this state it has been formed into a genus under the names of *Rimula* and *Puncturella*. But as the animal grows, the hole enlarges in size backwards, and the true apex being absorbed, the hole appears in the adult shell to be placed on the tip, and in some species even to extend behind it."

The muscular impression is in the form of a horse-shoe, with the opening in front.

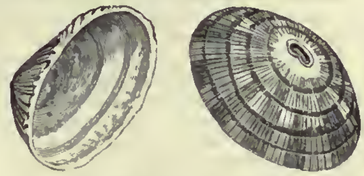
Animal of *Fissurella*.

Shell of *Fissurella*.

De Blainville thus arranges the genus:—

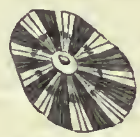
α. Species which have the middle part of the borders of the opening excavated as it were, so that when placed upon a flat surface, they only touch it at their extremities. Ex. *Fissurella nimbosa*.

Deshayes observes that the synonymy of this species has been very faulty from the time of Linnæus downwards; and he remarks that three species are confounded under *Patella nimbosa* in the 12th edition of the 'Systema Naturæ.' Deshayes adds that the species was named in Lamarck's collection, and that he has seen it, and therefore knows what Lamarck meant by his *Fissurella nimbosa*. The figure from which our cut is taken, that of Martini I. t. xi. f. 91-92, is one of those references which Deshayes would leave untouched as indicating the species.



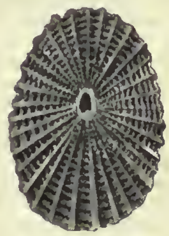
Fissurella nimbosa.

β. Species more depressed, &c., so that when placed upon a flat surface, the extremities are raised, forming a kind of canal. Ex. *Fissurella rosea*. Locality, Guyana, &c.



Fissurella rosea.

γ. Conical species with horizontal borders. Ex. *Fissurella Græca*. Locality, Mediterranean and Atlantic.



Fissurella Græca.

The distribution and habits of the *Fissurellidæ* are the same as those of *Patella*. Like that genus, *Fissurella* is littoral, and has been found at depths ranging from the surface to 25 fathoms.

The following species are described as British by Messrs. Forbes and Hanley: *Fissurella reticulata, Puncturella Noachina, Emarginula reticulata, E. rosea, E. crassa*.

Genera, *Emarginula* and *Parmophorus*.—Cuvier observes that the *Emarginulæ* have exactly the same structure as the *Fissurellæ*, with this exception, that the former, instead of the aperture at the apex of the shell, have in their mantle and shell a small slit or notch at their anterior border, which opens into the branchial cavity. The borders of the mantle envelop and cover a great portion of those of the shell.

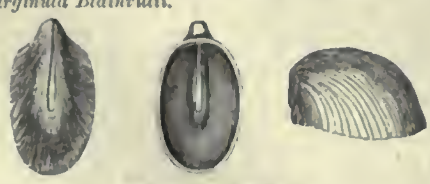
The eyes are situated upon a tubercle at the external bases of the conical tentacula. The edges of the foot are furnished with a row of filaments. G. B. Sowerby observes that "the animal of the *Fissurella* is very nearly related to that of *Emarginula*, as the shell is to the *Emarginula* itself; the fissure in the anterior margin of the latter serving for the same purposes as the perforation in the vertex of the former. One difference however is peculiarly observable, which is that in *Emarginula* the vertex is directed posteriorly, contrariwise to that of *Fissurella;* for Lamarck is mistaken in speaking of the notch or fissure in the edge of *Emarginula* as posterior." Of *Parmophorus* Cuvier says that, like the *Emarginulæ*, its shell is covered for a considerable portion by the turned-up edges of the mantle; this shell he describes as oblong, slightly conical, and without hole or notch. The branchiæ and the rest of the organs are the same as they are in the two preceding genera. G. B. Sowerby thus writes upon this point ('Genera of Shells'):—"*Emarginula* is more nearly related to *Fissurella* than to *Patella*, inasmuch as its branchiæ are not external, and the little fissure or notch in the anterior edge is only the termination of a narrow canal, that serves the same purpose in this shell as the perforation in the summit of *Fissurella*. It is observable that Lamarck has placed *Emarginula* next to *Parmophorus*, without seeming to have remarked the very great resemblance of the animals to each other; we have thought ourselves justified, both by the characters of the shells and of the animals, in uniting them; this may be objected to perhaps on account of the great difference in general form; but we answer that there are some species of Lamarckian *Emarginulæ*, one of which we have figured, which approach very nearly to Blainville's *Parmophorus* in shape. Another objection may raise from the apparent want of the anterior fissure in *Parmophorus* but it will be seen that the anterior edge of the shell is always somewhat emarginate, while in the situation of the branchiæ, the anterior fissure in the mantle of the animal, and in the position of the vertex in the shell, they exactly resemble each other; we therefore consider the *Parmophori* of Blainville and Lamarck as elongated and compressed *Emarginulæ*." Deshayes, in his edition of Lamarck (1836), thus expresses his opinion :—"Cuvier was the first who gave anatomical details of the genus *Emarginula*, and he made it appear how much analogy existed between it and *Fissurella*. There exists, nevertheless, between these two genera sufficient differences to warrant their continuance in systematic arrangement. But it is not so with regard to *Parmophorus*. M. de Blainville, to whom we owe this last genus, and who was the first to make the animal known, had judiciously preconceived the necessity of its junction with *Emarginula*. In fact, not only have the animals of the two genera a perfect analogy, and not only can they be with difficulty distinguished in some cases and in some species, but the shells themselves, as might have been supposed à priori, offer some passages from the one genus to the other, the number of which will be augmented by new researches. When we have before us a fairly complete series of living and fossil species belonging to the two genera the following observations occur :—The two fossil species of *Parmophorus* have no trace of a marginal notch; *Parmophorus Australis* has the anterior border a little depressed in the middle, and within the shell is to be seen, corresponding with this depression, a small crest indicating the separation of the mantle. Among the species of *Emarginulæ* brought home by Messrs. Quoy and Gaimard there is one which they name *Parmophoïda*, and which would seem to be entirely deprived of a marginal notch. In the *Subemarginulæ* of M. de Blainville the shells have no longer this notch, but they have within a deep ridge (sillon) in the place of it. In other species, as in *Emarginula rubra* of Lamarck and *E. elegans* of M. Defrance, the small interior ridge is terminated on the border by a very short notch; and from this commencement to the termination of the series of species we see this notch become deeper and deeper, and change at last into a deep slit occupying one half of the height of the shell." After dwelling upon the differences of the shells in other points of external form, M. Deshayes observes that the general aspect of the shells leads the zoologist to separate the genera, while the structure of the animals tends to fuse them into one, and thus concludes :—"M. Sowerby has come, as we have before said, to this conclusion, and in his 'Genera of Shells' has united the *Parmophori* to the *Emarginulæ*. This example will without doubt be followed by other zoologists."

We entirely agree in this conclusion, and consider the following arrangement of *Emarginulæ* by De Blainville as merely arbitrary, and calculated to assist the conchologist and fossil zoologist in his subdivision of this molluscous form.

Animal of *Emarginula*.

Shell of *Emarginula* (*E. conica*).

α. Species whose notch is in the middle of the back of the shell, and far from reaching the edge. (*Rimula?* or *Rimulaire?* of Defrance.) Ex. *Emarginula Blainvillii*.



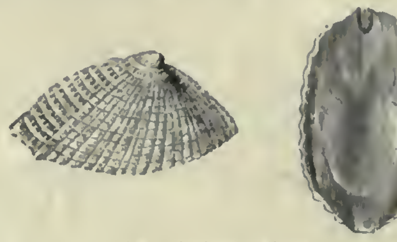
Emarginula Blainvillii.

β. Compressed species, whose anterior border is deeply notched, and the summit strongly marked. (Les Entailles.) Ex. *Emarginula fissura*.

γ. Species still more compressed, whose anterior border is only bent into a gutter, and whose summit is still evident. (*Subemarginulæ*.) Ex. *Emarginula emarginata*.

Emarginula fissura.

a, natural size; *b*, magnified; *c*, magnified, the shell turned up, showing the animal in situ.



Emarginula emarginata.

δ. Species very much depressed; the summit very little developed and præmedian, with a small notch. Ex. *Emarginula depressa*.

Emarginula depressa.

Parmophorus (*Scutum* of De Montfort).—Ex. *P. Australis*, syn. *elongatus* (*Patella ambigua*, Linn.)

Localities, seas of Australia and New Zealand.

Parmophorus Australis.

Emarginula and *Parmophorus* are littoral shells like *Patella*, and their habits are similar to those of the last-named genus. *Emarginula* has been found at depths ranging from the surface to 11 fathoms.

Fossil Fissurellidæ.—G. B. Sowerby says that a few fossil species are found in the truly marine formations above the Chalk. Deshayes, in his Tables, enumerates 33 living species and 8 fossil (tertiary). Of these, *F. Græca*, *F. costaria*, and *F. neglecta*, he states to be both living (the two former in the European and Indian oceans, and the latter in the Mediterranean) and fossil, in the pliocene (all three) and miocene (the two latter) periods of Lyell (Sicily, Italy in the sub-Apennine beds, English Crag, and Touraine). He mentions three Sicilian species, three Italian (sub-Apennine beds), one in the English Crag, two at Dax, two in Touraine, two at Angers, and four at Paris. The *Fissurella Noachina* of Deshayes, *Patella Noachina* of Lyell, is living in the northern seas, and found fossil in Sweden and Norway. It appears to be between a *Fissurella* and an *Emarginula*, and it is not impossible that it may be a *Fissurella* in a young state.

G. B. Sowerby ('Genera of Recent and Fossil Shells') observes that the fossil *Emarginulæ* are scarce. "They occur," adds that author, "in the calcaire grossier and its contemporary strata; in the crag of Suffolk, Essex, and Norfolk; and in the Bath oolite. They are very elegant little fossils, particularly Lamarck's *E. clypeata*. We cannot consider his *P. elongatus* as a species of this genus, for its vertex is anterior, as its muscular impression demonstrates; consequently we find in it no mark of a canal at either end; it must therefore be classed with *Patella*."

Deshayes, in his Tables, gives 7 living species of *Emarginula*, and 11 fossil (tertiary), one, *E. fissura*, an inhabitant of the European and

Mediterranean seas, fossil in the Crag at Bordeaux and Dax, and at Paris (Pliocene, Miocene, and Eocene periods of Lyell). De la Bèche enumerates two in the Blue Marls of the south of France, namely, one closely approaching *E. fissura* of Lamarck and *E. reticulata* of Sowerby. In the Cretaceous group he gives two, *E. Sanctæ Catherinæ* and *E. pelagica*, both from Rouen. In the Oolitic group he records one species, *E. scalaris*, Sowerby, from the great oolite at Ancliff, Wilts. Deshayes, in his edition of Lamarck (1836), enumerates 11 living species, and 5 found only in the fossil state, namely *E. costata* and *E. clypeata*, Lamarck, from Grignon; *E. radiola*, Lamarck, from Parnes; and *E. elegans* and *E. clathrata*, Deshayes, the first from Paris and Valognes, and the other, a rare species, from Parnes.

Deshayes, in his Tables, gives 2 living and 2 fossil species of *Parmophorus* (tertiary), one from Touraine (Miocene period of Lyell); and he enumerates 2 from the Crag, 3 from Touraine, 3 from Angers, 5 from Paris, and 2 from Valognes. In his edition of Lamarck he notes 2 species only as fossil, one, *P. elongatus*, Lamarck, with a variety, from Grignon, and the other, *P. angustus*, Deshayes, from Paris.

Woodward in his 'Manual of the Mollusca,' gives the following numbers of the fossil species of *Fissurellidæ*:—

Fissurella, 25 species. Great Britain and France.

Puncturella, 2 species. In the Glacial Formations of North Britain.

Emarginula, 40 species. Triassic, Britain and France.

Parmophorus, 3 species. Paris Basin.

FISTULA'RIA, a genus of Acanthopterygious Fishes, remarkable for the extreme elongation of the anterior part of the head, forming a tube, at the extremity of which is the mouth. The *Fistularia tabacaria* of the Antilles is the type. It lives on little fishes and *Crustacea*, which it draws out from the interstices of stones and holes in rocks by means of its long trunk or beak. Two other species are known, the *F. serrata* and the *F. immaculata*. They are all small fishes, not reaching two feet in length, slender, and eel-shaped.

FLABELLA'RIA, a genus of Fossil Plants. *F. borassifolia* is found in the Coal Formation. (Sternberg.)

FLACOURTIA, the type of the order *Flacourtiaceæ*, was named in honour of Etienne de Flacourt, a director of the French East India Company, and the commander of an expedition to Madagascar in 1648, of which he gave an account. This genus is diœcious; the staminiferous flowers have their stamens densely crowded, a hemispherical receptacle, and are glandless at the base; the pistilliferous flowers have the calyx 4-5-cleft, deciduous; the stigmas 4-9, each furnished with a longitudinal furrow above; the seeds long. The species are thorny shrubs, with whitish sepals and yellow stamens.

F. Ramontchi has roundish ovate acute crenated leaves. This shrub attains a height of 8 feet, and is a native of the island of Madagascar, where it is called Ramontchi. The fruit, which is edible, is about the size of a small plumb, is red when ripe, at length becoming violet-coloured. It has a sweet and acid taste. There is a small island off the coast of Madagascar which is covered with these trees. This island is called by English sailors Plum-Tree Island; by the French, Isle aux Prunes.

F. sapida has elliptical leaves, serrated, bluntish at both extremities. It is a native of the mountainous districts of the East Indies. The fruit is about the size of a common currant, and of a red colour. The fruit is eaten by the natives, and the tree is called by the Telingese Pedda Caurew.

F. inermis has elliptical crenato-serrated leaves, with short axillary racemes of hermaphrodite flowers. It is an unarmed tree, attaining a height of 30 feet. It has reddish-purple berries of a pleasant acid taste. It is a native of the Moluccas, where it is also extensively cultivated for the sake of its fruit. There are several other species of *Flacourtia*, all of them yielding edible fruits. The young shoots and leaves of *F. cataphracta*, which have the taste but not the bitterness of rhubarb, are considered astringent and stomachic, and are prescribed in the Circars accordingly. Tho infusion of *F. sepiaria* is thought to be useful as a remedy for the bites of snakes.

FLACOURTIA'CEÆ, or FLACOURTIA'NEÆ, *Bixads*, a natural order of Plants belonging to Lindley's parietose group of Polypetalous Exogens. It has from 4-7 definite sepals cohering slightly at the base; the petals equal in number with the sepals, and alternate with them, sometimes wanting; the stamens hypogynous, equalling the petals, or twice as many or some multiple of them, and sometimes appearing as scales forming a nectary; the ovary roundish, distinct, sessile, or slightly stalked; the style absent or filiform; the stigmas equal in number to the valves of the ovary, more or less distinct from each other; the fruit 1-celled, sometimes indehiscent and fleshy, sometimes capsular, 4-5-valved, filled with a fine pulp inside; the seeds few, thick, usually enveloped in a pellicle formed by the withered pulp, the albumen fleshy, somewhat oily, the embryo straight in the axis, with the radicle turned to the hilum, and therefore usually superior; the cotyledons flat, foliaceous. This order consists of shrubs and small trees, with alternate simple coriaceous leaves on short stalks, and axillary many-flowered peduncles.

The affinities of this order are with *Samydaceæ*, *Lacistemaceæ*, *Pangiaceæ*, and *Tiliaceæ*. They may be distinguished from all other plants by their unilocular fruit having their inside wholly covered with the placentæ. About 31 genera and 85 species are referred to this order.

These plants are natives of the hottest parts of the East and West Indies and Africa. Three of the genera—*Flacourtia*, *Hydnocarpus*, and *Chaulmoogra*—yield plants used by man; few, if any, are cultivated for ornament.

Hydnocarpus (from ὕδνον, a tuber, and κάρπος, a fruit) has diœcious flowers, the staminiferous ones with 5 stamens, 5 sepals, the two outer ones being ovate, 5 petals with villous margins furnished with a scale on the inside; the berry is spherical, terminated by four reflexed tubercles. There is only one species of this genus, which is a tree about 30 feet in height, the *H. venenata* of Gærtner, and *H. inebrians* of Vahl. It is a native of Ceylon. The fruit when eaten produces sickness, giddiness, and a dangerous form of intoxication. It is greedily devoured by fishes, which become stupified, but when taken in this way they produce poisonous effects as food.

Chaulmoogra (*Gynocardia*) is a diœcious genus; the staminiferous flowers with a 4-5-lobed calyx, 5 petals with a scale at the base of each; the pistilliferous the same, except the stamens, the ovary superior, 1-celled, with numerous ovules, and 5 parietal placentæ, 5 styles; the fruit succulent, dry, 1-celled, many-seeded.

C. odorata has short-stalked, alternate, bifarious, drooping, lanceolate, entire, acuminate, smooth, exstipulate leaves, 6 to 10 inches long, 1½ to 2½ inches broad. It is a native of Silhet. The seeds are employed extensively by the natives of India as a remedy for cutaneous diseases. In those cases they are applied externally; the testa being removed from the seed, the perisperm is beaten up with clarified butter into a soft mass, and applied to the part affected three times a day. The Indian names of this plant are Chaulmoogra and Petarkura. [PANGIACEÆ.]

Other genera belonging to this order are—*Ryanæa*, named by Vahl after John Ryan, who collected plants in Guyana; *Patrisia*, named after M. Patris, who collected plants in Guyana; *Roumea*, after Philippe Rose Roume de St. Laurent, an agent of the French government at St. Domingo, who was of great service to Poiteau, who travelled there; *Kiggelaria*, after Francis Kiggelar, a Dutch botanist of the 17th century; *Stigmarota*, *Melicytus*, *Erythrospermum*, *Pangium*, and *Vareca*.

(Don, *Dichlamydeous Plants*; Lindley, *Natural System*; Lindley, *Flora Medica*; Burnett, *Outlines of Botany*.)

FLAG. [IRIS.]

FLAGSTONE. A variety of Sandstone in which the laminated structure prevails is thus termed. Other laminated or thin-bodied rocks, as certain limestones and some argillaceous beds of the Silurian series, receive the same title. The laminations of flagstone arise from peculiarity of deposition; the laminations of slate (properly so called) arise from a new structure superadded to that of deposition, and possessing a certain symmetry and relations to lines and axes, which are at least analogous to crystalline arrangements.

FLAMINGO. [DUCKS.]

FLAX. [LINUM.]

FLEA. [PULEX.]

FLEABANE. [CONYZA.]

FLEXUOSI. [AMMONITES.]

FLINDERSIA. [CEDRELACEÆ.]

FLINT, a mineral substance composed principally of Silica. [SILICA.] It is found mostly in the Chalk Formation. The true origin of this mineral substance—as it occurs in the Chalk of Europe especially—has been, and still is, the subject of much discussion among microscopists and geologists. Mr. Bowerbank believes generally in the origin of flints (and some allied minerals) from sponges. In confirmation of this view spicula, such as characterise the Siliceous Sponges (*Halispongia*), are found in flint, and on the surfaces of flints peculiar marks of organisation referrible to spongeous texture. Ehrenberg, finding in some flints abundance of Infusorial *Animalcula*, suggests the origin of flint from aggregations of these siliceous-shielded *Microzoaria*. Mr. Charlesworth has recently found flint occupying the closed pulp cavity of a tooth of *Mososaurus*, and regards this fact as opposed to both speculations.

There can be little doubt that, whatever substances are found in the flint, or it may be found in connection with, it has been deposited from solution in water. Not only is flint found in connection with sponges and *Infusoria*, but also with *Echinodermata* and other animal remains of the Chalk. The substance called Chert has the general characters of Flint, and frequently contains in its interior loose particles of sand. [AGATE.] From this circumstance there can be little doubt that the chert has been formed from the deposit of silica upon rolled masses of sand. In the same manner it appears probable the siliceous matter has been deposited in the cavities left by sponges and other animals after they had been covered up by the chalk at the bottom of the ocean. It has been supposed, in the case of sponges, that this process goes on at the bottom of the sea, but this is highly improbable, and it is much more likely that the flint is formed by a process of percolation long after the animal remains with which it is found in contact have been buried up by the chalk. That silex is readily made to assume this form is seen in the cases of silicified wood, in its deposit in vegetable structures, in its existence around the locality of geysers, and in the very ready manner in which it is precipitated in an insoluble form from its solutions.

FLINTY-SLATE, or SILICEOUS SCHISTUS, is a substance which is found chiefly in beds in transition mountains. It occurs in Saxony, the Harz, Bohemia, &c. It occurs also in Scotland, in the Pentland and Muirfoot Hills, in the Isle of Skye, &c.

The substance is of various colours, gray, bluish-gray, and red; its structure is rather slaty; on the edges it is translucent; it is dull, or only glimmering; hard, and broken with difficulty.

It contains about 75 per cent. of silica, the remainder being lime, magnesia, and oxide of iron.

The Basanite, or Lydian Stone, is considered to be a variety of flinty-slate; it has not however a slaty structure, and is not so hard as flinty-slate. It occurs in Bohemia and Hungary, but was first brought from Lydia in Asia Minor, whence its name. It is employed when polished for trying gold by a comparison of colours, and has thence obtained the name of Touchstone.

FLIXWEED. [SISYMBRIUM.]

FLOAT-STONE, a variety of Quartz found in the Chalk Formations of Menil Montant, near Paris. It consists of fibres or filaments aggregated in a spongy form, and so light as to float in water.

FLOOK, or FLUKE. [PLEURONECTIDÆ.]

FLORA. The collective vegetation of a country is called its Flora, in the same manner as the animals are called its Fauna. Thus we speak of the Flora of Great Britain, the Flora of Europe, meaning thereby all the plants growing in those parts of the world. The term is also applied to books, or lists, descriptive of the plants of a country.

FLOS FERRI. [ARRAGONITE.]

FLOUNDER. [PLEURONECTIDÆ.]

FLOWER, that part of a plant in which the organs of reproduction are placed. The flower originates from a bud, and is nothing more than a particular modification in the perfecting of the parts contained in the bud; namely, the several foliar organs and internodes. Only two essential processes of development can exist, and from those only two essential organs, as fundamental organs, can be formed in the plant; namely, the Axis and the Leaf. All the several parts of the flower must therefore be referrible to these fundamental organs, and be traced back to them. Since Göthe's time this tracing back has been termed the Metamorphosis of Plants. Originally this mode of considering the flower rested solely on Comparative Morphology, and the observation of cases in which the interruption of the usual processes of development, in some or all parts of the flower, caused those parts to reassume forms in which it was not difficult to recognise the nature of the fundamental organ from which they had been produced. This latter has been termed Retrogressive Metamorphosis. As examples of it, we may mention the different monstrosities, the doubling of a flower through the transition of the stamens into petals, the transition of the petals and sepals into the common leaves of the plant, &c. This mode of establishing the foundations of the doctrine of metamorphosis has however two essential faults: since, in the first place, it seeks to obtain individual facts by means of hypotheses and comparisons; while, secondly, its progress depends entirely upon favourable circumstances. The only correct and sure ground on which to rest this doctrine is the history of development.

In Phanerogamic Flowers the following parts are distinguished, proceeding from without inwards:—1. The Floral Envelopes, as the External Calyx (Epicalyx), of which the parts are Leaves (Phylla); the Calyx, the parts of which are Sepals; the Corolla, the separate portions of which are Petals; or, instead of these three, the Perianth (Perianthium), whose separate parts are Leaves (Phylla): 2. The Stamens (Stamina), around and within which some stunted accessory foliar organs appear under very various names: and lastly, 3, in the centre of the flower, the Pistil (Pistillum), the separate foliar organs of which are Carpels (Carpella). In the stamens the lower thread-like portion, which is termed the Filament (Filamentum), is distinguished from the upper thick and hollow part, containing the Dust (Pollen), called the Anther (Anthera). In the pistil, the lower part surrounding the Ovules or Seed-Buds (Gemmulæ) is called the Germen; the upper free part, which is usually covered with papillæ, is termed the Stigma, and between these two frequently a stalk-like elongation of the germen occurs, called the Style.

The flower of *Phanerogamia* is the only physiologically determinate organ of the plant, since it contains the apparatus for the regular propagation. But to this only two parts contribute—namely, the stamens, as generators and receptacles of the pollen; and the seed-bud or ovule, as the place in which the pollen is developed into the embryo. All the remaining parts of the flower—namely, the envelopes of the whole perianth, the calyx and corolla, the receptacles containing the seed-bud (the germens, styles, and stigma), are not, in a physiological sense, essential, and they may be absent, without the flower losing its correspondence to the character by which a flower is defined.

In the correct (morphological) view of the flower, there is no distinction between essential and inessential forms, and therefore it is necessarily more proper to divide it into axial and foliar organs. The following relations should be borne in mind:—The axis and its modifications are the basis of the flower, because to them the foliar organs are attached. Attached to the outer part of the axis of the flower occur several forms of true foliar organs, the floral envelopes, accessory leaflets, and stamens. The innermost part is occupied by organs which are formed from true axial organs, or an intimate blending of these with foliar organs, which are termed the female apparatus, or better, the rudiment of the fruit. At the same time the parts of the flower are usually grouped together and treated generally, according to the relations of number and position, as well as of duration. Thus we obtain this plan for our following investigations:—

A. The Axial Organs of the flower.

B. The number, relative position, and duration of the parts of the flower.

C. The true Foliar Organs of the flower.
- *a.* The Floral Envelopes.
- *b.* The Stamens.
- *c.* The Accessory Foliar Organs.

D. The Rudimentary Fruit.
- *a.* The Pistil.
- *b.* The Spermophore.
- *c.* The Seed-Buds.

The Anthers have been called the male organs of a plant (with the superfluous collective term Andrœceum); the Seed-Buds and their receptacle the Pistil, the female parts (together the Gynœceum). A flower that contains both parts is termed Hermaphrodite (Flos Hermaphroditus). Flowers that contain only one of those kinds of organs are termed Unisexual Flowers (Flores Unisexuales, Diclini). When, in the last case, male and female flowers (mas et femina) appear on the same individual plant, such plant is termed Monœcious (Planta Monoica); when they appear on separate individuals the plant is termed Diœcious (Planta Dioica). An Inflorescence which contains both male and female flowers, also is termed Inflorescentia Androgyna. Here again it must be distinguished whether the male and female blossoms are formed upon different plans, as in the *Cupuliferæ* (Diclines); or whether, through the suppression of one or other part, a pseudo-diclinous condition appears in a flower formed on the plan of a hermaphrodite. This latter condition, which is never found to run through all the examples of any species of plant, brings monœcious and diœcious species into hermaphrodite genera, and suggested to Linnæus the establishment of his 23rd class, *Polygamia*, where in one and the same species male, female, and hermaphrodite flowers are present.

There are very few flowers of so simple a structure that they consist only of one simple essential part, so that no formation of internodes is possible within the flower; and the extremity of the pedicels immediately supports the floral parts existing. This is the case in the male flower of the *Euphorbiæ*, where the end of a pedicel bears one single stamen; also in the male flower of the *Abietineæ*, where one single foliar organ, converted into a stamen, constitutes the entire flower. It is also the case in the female flower of *Taxus*, where the small pedicel, clothed with bracts, terminates immediately in the naked seed-bud. In the generality of flowers however several parts are united which do not stand at equal heights on the axis, and thus more or fewer undeveloped internodes take part in the structure of the flower. The original condition of the internodes, is here also most frequently permanent; and the pedicel, after the detachment of all the parts of the flower, frequently ends in a small slightly thickened knot, which represents the collective internodes of the flower in an undeveloped condition,—the simple base or receptacle of the flower (Torus). Examples in which individual internodes become elongated are rather rare. In some families they are elongated between the inner floral envelopes and the stamens (Androphorum), and between the stamens and the germen (Gynophorum). The latter is generally termed Germen Stipitatum. There are examples of both in the *Passifloraceæ* and the *Capparidaceæ*.

A considerably longer part, without elongation of the individual internodes, frequently occurs as a gynophore in flowers which contain many germens (as in the *Rosaceæ*, the *Ranunculaceæ*, *Magnoliaceæ*, &c.) Again, the gynophore is often presented as a hemispherical or cushion-like part, as in some other *Rosaceæ* and *Ranunculaceæ*. A very rare form of it is that of a reversed cone, which bears the germens upon a base turned upward, as in *Nelumbium*. In the rarest instances, with the exception of this case, the axis of the flower is elongated within the floral parts even without ending as a germen; but this does sometimes occur, as in the male flowers of some Palms and other plants; for example *Chamædorea*, where the points of the petals unite with the apex of the axis of the flower which passes up through them.

In very crowded inflorescences, the torus of an axillary bud developes obliquely, and rises up on one side, especially beneath the germen, so as to appear as a part of its side-wall; this happens with most of the Grasses. A similar circumstance, arising from a similar cause, happens when many single germens are present in one flower, by the division of the torus, which forms the basis of each of those germens, and thus assumes the appearance of forming a part of the wall of the germen (as in *Potamogeton* and *Dryadaceæ*).

But the developement of the internodes into a Disc, or in a hollow cup, is far more frequent in the flower. If the collective internodes of the flower form a hollow body, or even a cylindrical elongated tube, which incloses only seed-buds, and bears all the floral parts upon its upper edge, all this is the so-called Inferior Germen or Ovary (Germen Inferum).

Every other similar expansion of the internodes of the flowers which does not immediately bear seed-buds, is called the Disc (Discus). This may be situated beneath the rudiment of the fruit (Discus Hypogynus), and then may be flat, as in *Potentilla* and *Fragaria;* or cup-shaped, as in *Rosa*, *Populus* (*mas*), &c. This latter may be free (*Rosa*), or may be blended with the germen situated inside it (*Pyrus*); or it may pass off from the middle of the (half-inferior) germen (Discus Perigynus), as in many *Myrtaceæ;* or, lastly, it may rise above the (inferior) germen, and stand upon it (Discus Epigynus). Here it is very rarely (or never?) flat, but funnel-shaped, as in *Godetia;* in the form of a long tube, as in *Œnothera;* or resembling a style, as in the *Orchidaceæ* and *Aristolochiaceæ*. In all these cases, the foliar organs of the flower may be situated in very different places. Usually, indeed, they collectively form a zone around the edge of the flat or concave discs; then the discs may be said to correspond to as many discs lying one above another as there are internodes implied by the number of foliar organs. Frequently the true foliar organs stand around the edge of the disc; and upon its inner or upper surface the germens are arranged in one or more circles (as in *Rosa*, *Punica*, *Onagraceæ*). More rarely the floral envelopes alone stand on the border, while the stamens are then at a distance from them, upon an internal prolongation of the disc, as in the *Orchidaceæ*.

The disc is by no means always regularly developed, but sometimes enlarged at one side only, whereby the whole flower appears oblique, thus in *Reseda*. The most remarkable structure is in *Pelargonium*, where the disc forms a cavity to one side of the peduncle, and in *Tropæolum*, where the spur is formed solely by the disc.

There are but few special observations to be made respecting the structure of the internodes of the flower; it is in general like that of annual stems; but it should be remarked that they often possess fewer vascular bundles, and these of simpler development. The internodes (as also some of the foliar organs) within the flower, frequently do not have the epidermis developed, but, instead of this, a delicate soft cellular tissue, somewhat yellowish in colour, and often containing a saccharine secretion, forms the investment of the surface (Nectarium).

It is very rarely that a flower consists of one part only, as in the male flowers of *Euphorbia*, *Lemna*, and *Wolffia*, which are formed of one foliar organ, the anther; or the female flower of *Taxus*, which is formed of one axial organ, the seed-bud. Usually more parts unite to form a flower: thus the female flower of most of the *Araceæ* consists of one or more seed-buds, and a carpel surrounding them. The male flower of the *Salicaceæ* consists of a scale-like disc and several stamens. In the generality of cases, male and female organs are both present in the same flower: they are seldom naked, as in *Hippuris*, but usually surrounded by floral envelopes.

In axillary flowers, those parts which are turned towards the peduncle are termed the upper, and those turned towards the bract, where it is present, the lower. Some plants exhibit the peculiarity that the pedicel, until the time of the blooming, makes a half turn (analogously to the twining stem), and it may be the true pedicel, as in *Calceolaria* and some *Orchidaceæ;* or the inferior germ, as in most of the *Orchidaceæ*. By this curve, the upper parts of such a flower (in those plants the lip) become apparently the under; and such flowers are termed Flores Resupinati. The term is sometimes falsely applied to those *Orchidaceæ* in which no such twisting takes place, but in which the lip stands regularly as the upper part of the flower, as, for example, in *Epipogium*.

The individual organs of the flower taken generally, according to the common view, and known by collective names, may originally consist either of one piece or of more than one: in the first case they are partes monomeræ; in the second case partes di-, tri-, or polymeræ. In the latter case the parts may be entirely separated and independent of one another, or they may be grown together in various ways. These coherent sets were formerly also called partes monomeræ. De Candolle better termed them partes gamomeræ; as, for example, *Hemerocallis* = perianthium gamo- (mono-) phyllum, hexamerum; *Salvia*, corolla gamo- (mono-) petala, pentamera; *Rosa*, coralla pentapetala, &c.

The coherence occurs here in the same manner as in the stem-leaves, but on account of the crowded position in the flower-bud, much more frequently. It happens either that a single foliar organ grows together by its edges into a tubular or cup-like organ, as for example occurs frequently in the so-called monomerous floral envelope (Bracteole); or that several foliar organs grow together by their edges: this commonly affects all the edges of a circle of leaves, but sometimes two edges remain ununited, as with the calyx of *Gentiana lutea*. So, again, this process is usually simultaneous in development at all the edges of a circle; but it sometimes happens very much later—*a*, on two uppermost leaf-edges, whereby the single-lipped forms arise, as in the corolla of *Teucrium* and the flores ligulati of the *Compositæ;* or, *b*, with each pair of leaf-edges at the side of the leaf-circle, whereby the two-lipped forms (partes bilabiatæ) of descriptive botany arise. Another kind of blending also occurs in the flower, of which no example occurs in the stem-leaves, and only one in the bracts and bracteoles, namely, the cupula of the *Cupuliferæ;* this is, the blending together of two or more circles, as in the two circles of the floral envelopes of many *Liliaceæ;* or in these and the two circles of stamens, in the circle of petals and stamens, in the *Labiatæ*, &c.; and in general in all flowers to which are ascribed stamina perianthio vel corollæ (not calyci) inserta.

The coherence of the stamens of one or more circles has been well termed, since Linnæus's time, fraternity (Adelphia); and, according to the number of brotherhoods in a flower, Monadelphia, Diadelphia, Polyadelphia. When the foliar organs of the flower are coherent, the blended part is termed the Tube (Tubus Perianthii, Calycis, Corollæ, &c.); the free parts, the Limb (Limbus); and the boundary of the two, the Throat (Faux). One of the most striking examples of coherence, which also has no analogue in the stem-leaves, is found in the blending of the foliar organs of the flower at the point only, the union never extending farther; so that the foliar organs are connected above, but free below, as in the corolla of the male flowers of *Chamædorea*, *Casuarina*, and in the androphore of *Symphyonema montanum* (?).

Abortion in the flower means that some part present in the rudimentary condition is arrested during the development and gradual perfecting of the flower, and thus at last retires from observation. There is no other kind of abortion. So soon as the individual parts of a flower become distinct members, the foliar organs appear arranged around an ideal and real axis of the flower (the axial organs of the flower), and in the rudimentary condition always regularly. Through subsequent unequal development of the single parts, the flower frequently becomes unsymmetrical, or, as it is called, irregular. This irregularity is always such that the upper part of a flower becomes developed differently from the under. Such irregularity very seldom affects the germen, which almost universally remains regular even in unsymmetrical flowers; yet there are cases in which this is the only symmetrical part, as in many of the *Scrophularaceæ*, *Acanthaceæ*, and *Cryptocoryne spiralis*. If the unsymmetrical flower, with or without coherence of its parts, is divided into two halves, an upper and under, developed in different ways, they are generally termed bilabiate; but if only one single foliar organ is developed in an aberrant form, that leaf acquires the name of Labellum, or Lip. Rare indeed are the cases where the entire flower is unsymmetrical, as in *Goodyera discolor*.

It is not possible to state in general terms the number of parts which may unite to form a flower. We find of foliar organs alone sometimes as many as fifty or sixty united in one flower. Certain combinations, on the contrary, are rarely met with: no monomerous flower possesses double floral envelopes. When the various parts of the flower are present in large numbers, these arise universally in one or more circles (Whorls) at the same height on the axis, and at the same time. When circles containing members of equal number follow in succession, the members of the one circle usually stand opposite the interspaces between the members of the preceding circle (the circles and their members alternating); they seldom stand precisely before them (the circles and their members opposite). But it by no means is to be assumed that the members of each circle are always of equal number in a flower. The number of members often increases up to the stamens, and thence diminishes; it is rare for the circle of the carpel to contain the greatest number, as in the *Malopeæ* and *Malvaceæ*. The generality of monocotyledonous plants with perfect individual flowers have regular homomerous circles through the entire flower: in dicotyledonous plants this is relatively rarer; the outermost and innermost circles have usually fewer members. Again, respecting the number of circles which follow one another, no general statement of importance can be given. Seven different forms of foliar organs may possibly exist in the same flower, namely, the epicalyx, calyx, corolla, accessory corolla, the stamens, accessory stamens, and the carpels; but there is no flower in which all occur in conjunction. All these foliar organs may be present in one or more circles, with the exception of the epicalyx, in which there is no example of a double circle. Perianth, calyx, corolla, accessory corolla, and carpels occur in one, or more rarely in two circles. Stamens may be present in one, two, three, or possibly even four circles; more circles than this are not exhibited in the normal condition of the flower. If the number is increased, which seldom happens except in stamens and carpels, as in *Ranunculaceæ* and *Dryadaceæ*, the *Magnoliaceæ*, &c., they stand no longer in circles but in a spiral. In monocotyledonous plants with perfect individualised flowers, with the single exception of some *Scitaminaceæ*, five trimerous circles of foliar organs of the flower appear to be formed in those where a second circle of petals exists. The greatest multiplicity of forms occurs in the dicotyledonous plants. *Lavatera*, for example, has an epicalyx, calyx, corolla, stamens, and carpels in five circles, with increasing numbers of members; those of the calyx and corolla alone are equal. *Gnidia virescens* has perianth, stamens, accessory stamens, and carpels, but in eight circles, which are throughout composed of two members each. It is by no means necessary that all the parts of a circle of floral foliar organs should be ultimately developed in the same manner; and many floral structures which have hitherto been apparently inexplicable may probably, by keeping this truth in mind and following out the history of the development, be readily traced back to the original type.

The duration of the individual parts of the flower is very various; the axial organs, so far as they support the rudiment of the fruit or aid in its formation, persist naturally at least until the ripening of the seed, then fall away with it; or if it becomes disengaged from them, die away with the remainder of the plant. When axes bear only male organs or flowers their duration is different; sometimes they are cast off at a true articulation, sometimes they remain upon the parent plant, and gradually die away. The foliar organs of the flower are equally various in their duration. Perianth, corolla, and accessory corolla commonly perish soon after the perfecting of the flower; either they are cast off by true disarticulation, or they wither upon the parent plant. The epicalyx and calyx frequently share the fate of the axial organs supporting the rudiments of the fruit; the carpels almost invariably. The carpels are rarely destroyed before the perfecting of the seed, as in *Leontice*, and according to Robert Brown in *Peliosanthes Theta*. The stamens die away almost immediately after the dispersion of the pollen; either they are cast off, or they dry up and die away within the flower.

The terminology in use is as follows:—Those parts which fall away immediately, when their perfect formation is but scarcely completed, are termed caducous or fugacious (partes caducæ); those which endure somewhat longer are termed, if they are cast off by disarticulation, deciduous (partes deciduæ); if they retain their position, and die by gradual withering and drying up, marcescent (partes marcescentes); those parts which remain long, still vegetating, are termed persistent (partes persistentes); if they change their forms by further growth they are termed excrescent (partes excrescentes).

As among the floral envelopes are usually reckoned the perianth, the calyx, and the corolla, we may also include here the epicalyx. Under the term perianth, in its narrowest sense, only those foliar organs fall which, at least two in number, are applied closely to the flower and upon one level; so that all individual foliar organs on the axis of the flower, which only inclose stamens or germens, may be termed bracts. All these bracts have this in common, that they are merely foliar organs peculiarly modified; and consequently all the peculiarities of form which occur in the latter naturally appear in the former also. It is not often that the leaves of the floral envelopes have great thickness; they are almost always more or less flat. But the forms analogous to the pitchers or pouches are here frequent, much more so than is the case with the stem-leaves; and these are termed, according to their various resemblances to objects, cup-shaped, as in the lower petal of *Polygala*; hood-like, as in the upper leaf of the perianth of *Aconitum*; and so on. If a long sac-like appendage is formed at the basis of a perianthial leaf expanded above, it is called a spur (calcar), as in *Orchis*, *Delphinium*, *Fumaria*, &c. The formation of the spur is frequently conjoined with the formation of a symmetrical flower, where one upper or lower foliar organ forms a spur. The flattened expanded form, which is connected with the axis by a linear prolongation, frequently occurs in the sepals (?). This expanded surface is termed the limb or blade of the leaf (lamina); the narrowed base is not termed petiole but claw (unguis). True articulation is frequent between the floral envelopes and the axis, but it never occurs in the continuity of these leaves (?); therefore there are no true compound perianthial leaves, though a simply divided limb is frequent, as the petala palmatifida in *Reseda*, the petala pinnatifida in *Schizopetalum*, &c. An indication of true articulation may probably be afforded in the separation of the upper part of the tube of the flower in *Mirabilis*, of the calyx of the *Datura* from the lower, and in some similar cases.

True stipules are not met with in the floral envelopes, but appendages analogous to the ligula appear, to which indeed a part of the structure described as the corona belongs. As in the *Narcissus* and the *Lychnis*, the scales of the throat of the *Boraginaceæ* also belong here. These parts are formed in very various fashions on the floral envelopes, and such appendages are sometimes exhibited standing upon the surface of the foliar organ, in three or more rows, one above another. Almost all parts recognised as corona and accessory corolla (paracorolla) belong here, in particular a part of those elegant forms exhibited in the *Stapeliaceæ* and the *Passifloraceæ*; so also does a portion of the so-termed nectaria, as, for example in the petals of *Ranunculus*. All these are mere dependent appendages of the foliar organs, which are developed originally simple and flat, all these parts being produced from them subsequently. Here also occurs the one-sided development of a foliar organ: this is seen frequently in the petals of the *Apocynaceæ* (*Vinca*, *Nerium*, and *Cerbera*).

The collective form of one or more circles, whether coherent with each other or not, is more accurately designated according to further peculiarities, as tubular (tubulosum), bell-shaped (campanulatum), funnel-shaped (infundibuliforme), salver-shaped (hypocrateriforme), rotate (rotatum), &c.

Five kinds of floral envelopes are easy to be distinguished. When all the foliar organs are similarly or nearly similarly developed in a circle of one evident form, colour, and structure, they are described under the general name of perianth, the single organs of which are called perianthial leaves. If in the floral envelopes of one flower we can distinguish two circles differing in form, colour, and structure, the outer is named the calyx, its component organs being sepals; while the inner is termed the corolla, its single parts petals. Then if three circles of forms are distinguishable the outermost is called the epicalyx, the leaves of which may be denominated phylla. When between the simple or manifold floral envelopes and the stamens other independent foliar organs occur which exhibit a structure very imperfect and abnormal compared with the true envelopes, these are called a paracorolla, of which it will be necessary to speak further on, among the accessory parts of the flower.

The Perianth consists, according to the preceding considerations, of one or more circles of leaves, which are developed so as to be similar in colour, form, and structure. The following series of its forms may be more minutely characterised:—

The individual foliar organs are always expanded in a flattened form, seldom divided into limb and claw, and, at least when they are not coherent, usually oval or lanceolate. They may be green, as in the male flower of *Urticaceæ*, or of various colours, as in *Thymeliaceæ*; they may be firm and solid, and that especially when green, as in *Elæagnaceæ*; or of delicate texture, as in *Aristolochiaceæ*; or they may be developed as delicate sapless scales (paleæ), or bristles and hair, as in the *Typhaceæ* and *Cyperaceæ*. The perianth is almost universally regular, rarely (in some *Ranunculaceæ* and *Orchidaceæ*) symmetrical; in these cases never (?) 2-lipped, but often with one lip, as in the *Orchidaceæ*. This is then not unfrequently developed, hollow (cucullatum in *Aconitum*, calcaratum in *Orchidaceæ*), and it is commonly the uppermost leaf of the perianth. Its foliaceous portions may be free, as in *Juncaceæ*; or coherent, as in *Funkia*, *Hemerocallis*, &c.; they may consist of one circle, as in *Urticaceæ*; or of more, as in *Liliaceæ*. The parts are frequently blended with the stamens: in the coherent perianth the tube is sometimes straight, as in *Narcissus*; sometimes curved, as in *Aristolochia*. The mouth is mostly naked; sometimes, but seldom, as is the case in *Narcissus*, furnished with appendages which form a corona, which however are rare in the perianth, and in free foliar organs only (?) occur on the lip: the inner circle often has a beard.

The structure of Perianthial Leaves, is on the whole, that of very simple leaves, which exhibit no specal peculiarities, particularly if they are green. The ramifications of the vascular bundles are therefore simple; the separation into an upper and under parenchyma layer is seldom exhibited; but the epidermis usually. In the coloured and delicate parts the cells of the parenchyma contain colouring matter. In general the parenchyma is very loose and almost spongy, with homogeneous transparent fluid contents, and large intercellular cavities filled with air; hence the white colour. The epidermis is less developed in coloured leaves, and more resembles the structure of epithelium; stomates are sometimes present, especially upon the under surface, but the epidermal cells of the upper surface are often raised in shorter or longer papillæ, which give the upper surface a peculiar velvet-like appearance. It is very frequent here to find the secreted layer of the epidermis (cuticle) regularly and delicately striated (aciculatus), which certainly contributes to heighten the brilliancy of the colour, and perhaps, by its effect upon the rays of light, to the production and modification of the peculiar tints.

Occasionally, especially at the base of hollow parts, no epidermis is produced at certain points, and the parenchyma assumes a peculiar structure, to perform the function of secretion of a juice containing much sugar; as, for instance, the nectary at the base of the perianthial leaves of *Fritillaria*, very various parts on the labellum of the *Orchidaceæ*, &c. In rare cases the texture is hard and almost woody from the interspersion of many thickened porous parenchymatous cells, as in the species of *Banksia* and *Dryandra* (?). In paleaceous perianths the spiral and other vessels are not found in the usually simple vascular bundles, and in hair-like perianths even the vascular bundles themselves are wanting.

The Calyx only exists when a corolla occurs with it; it therefore can never be confounded with it. It is always the external of two dissimilar sets of envelopes. Its series of forms very much resembles those of the perianth; perhaps it is not so frequently delicate in structure and colour, as in the *Scitaminaceæ*, *Musaceæ*, *Butomaceæ*, *Ranunculus*, *Tropæolum*, &c. Usually it consists of one circle of sepals, more rarely of two (as in the *Berberidaceæ*). These sepals are always very simple, oval, or lanceolate, seldom pinnatifid, very frequently broad at the base and tapering to a point, or very small (dentes calycis obsoloti); sometimes they appear only as dry scales, or as tufts of hair (the pappus of the *Compositæ*). Appendages seldom occur upon the sepals, but they are frequently of hollow or concave form. The number of the sepals in each circle is in Monocotyledons frequently three, more rarely four or two; in the Dicotyledons it is most frequently five, but also two, three, or four, and perhaps sometimes more. Coherence of the sepals with one another may occur in every way, but never with the corolla and stamens, nor with the germens; that which is so called being quite another condition. Both in free and in coherent sepals, regularity and symmetry are met with; the latter often exhibit the bilabiate structures.

That which has been said of the structure of the perianth applies also to the calyx, only that here green foliaceous sepals are the more frequent.

The Corolla, which only exists as the inner set of floral envelopes accompanying a calyx, may be compared to a very delicate and coloured perianth. No true corolla occurs perfectly green and resembling the leaves; its series of forms is greater than that of any other of the floral envelopes. In the Monocotyledons it presents in general only simple, round, oval, or lanceolate leaves, very seldom having claws. In the Dicotyledons the forms are infinite, as are also the variety and splendour of the colour. The following are the main points in the structure of this organ:—

The individual petal exhibits, on a reduced scale and in a delicate condition, almost every variety of form of the leaf, with the exception of the truly compound. Concave forms are here frequent, such as the hood-shaped, pitcher-shaped, or spurred petals, &c.; these latter very often on individual petals of an otherwise regular corolla as in *Fumaria*. Fringed and feathered forms, as well as variously lobed petals, are also hy no mcans rare. The limb and the claw are often clearly to be distinguished. Parts analogous to the ligule, and every imaginable form of appendage, with the exception only of the stipules, occur frequently, and characterise genera and families.

On this account it is indispensable to distinguish the simple appendages of the petals from the independent foliar organs. To the former belong tho scales (fornices) of the *Boraginaceæ*, the scales of the corona of the *Silenaceæ*, the formations generally described as coronæ in the *Stapeliaceæ* and some other *Asclepiadaceæ*, the uectaria of *Ranunculus*, *Parnassia*, &c.

The corolla consists of one circle, rarely of two (three series in *Berberis*), or more (four series in *Nymphæa*). In Monocotyledons the number of members is equal to those of the calyx; in Dicotyledons the number of five in a circle predominates, though it is sometimes composed of two, of four, or of a greater number in *Dryas*. The number of members is equal to that of the calyx, or greater; very rarely indeed it is smaller; this last case occurs with *Hibiscus*. Suppression is not infrequent, and sometimes involves all the foliar organs of a corolla at once, as in the summer flowers of many species of *Viola*, in *Lepidium ruderale*, and in some species of *Acer*. The coherence of organs in every way is still more frequent; never indeed with the calyx or the germens, hut frequently with the stameus.

The corolla, whether with free or with coherent petals, may he regular or only symmetrical. In tho latter the hilabiate formation is tho most frequent, especially in five-membered circles, in such a way that, according as the odd petal is on the upper or the under side of the flower, the upper lip consists of three or of two petals. In the latter case these two are very often little or not at all coherent, as in *Teucrium*, the so-called radiated flowers of tho *Compositæ* (florihus ligulatis vel radiatis). Peculiar forms of symmetrical flowers are, for iustance—the personate flowers (corolla personata), in which the upper petals of a coherent corolla are so curved inward that they close the entrance of tho tube (as in *Antirrhinum*), the incurved portion is termed the palate (palatum); the true hilabiate or mouth-like corolla (corolla ringens), in the *Labiatæ*, in which the two petals forming the upper lip often present a concave form overhanging the lower lip, termed galea; the so-called papilionaceous flowers of tho *Leguminosæ*, in which the uppermost leaf, which is broad and large, surpassing the others, is termed the standard (vexillum), whilst the lateral petals, as wings (alæ), are usually dissimilarly developed, and the two undermost, very frequently coherent, also developed unequally at the two sides, approach each other in a concave form, so as to form tho keel (carina). Sometimes all the petals of the papilionaceous flowers become coherent at the lower part, and form a tube, as in *Trifolium*; or individual petals are abortive, &c. The most irregular of all the forms have hitherto received no names; such as appear for instance in the *Polygalaceæ*, the *Balsaminaceæ*, *Tropæolaceæ*, &c.

All that was said respecting the structure of the perianth holds also for the structure of the corolla, rememhering only that this is more delicate. The contents of the cells vary much in colouring matter, and their distrihution in groups is sometimes very remarkable. Very dense texture, in consequeuce of the presence of much-thickened porous cells, as in the *Amarantaceæ*, is infrequent. The structure of the epidermis, and its development into papillæ, hairs, &c. is very manifold. Development into surfaces secreting nectar, both at the hottom of concave forms and upon tho appendages, is especially common. The petals also occasionally secrete a viscous substance, in consequence of which they adhere together, as happens at the points of the inner petals of the *Fumariaceæ*.

The Epicalyx is seen where three separate series of foliar organs are distinguishable in the floral envelopes, and it is the outermost of these. There are not many plants which exhibit an epicalyx. In form and structure it much resembles the calyx. It occurs with free leaves (as in *Passiflora*), and coherent leaves (as in *Lavatera*). Its leaves are seldom delicate, such as are seen in the corolla, but are often dry and membranous (as in *Scabiosa*), but generally green and leafy (as in the *Malvaceæ*).

For an account of the other organs of tho flower, see STAMEN; FRUIT; PISTIL; SEED. For the functions of the flower, see REPRODUCTION IN PLANTS.

(Schleiden, *Principles of Scientific Botany*.)

FLOWERING-FERN. [OSMUNDA.]

FLOWERING-RUSH. [BUTOMACEÆ.]

FLUCERINE, the name given to tho native Deutofluate of Cerium, which occurs at Finbo and Broddbo, near Fahlun, in Sweden. It occurs both massive and crystallised. The crystals are either six-sided plates or prisms; they have a yellow or reddish colour; fracture uneven; dull; translucent, in very thin fragments: when heated by the blow-pipe on charcoal it hecomes slightly hrown, hut does not fuse; in the reducing flame it becomes colourless, and in the oxidating flame, with borax and a phosphate, it yields an orange-coloured globule: when heated iu a tube with an acid, the glass is corroded.

FLUELLITE, a compound of Fluoric Acid and Alumina, which occurs at Stenna-Gwyn, in Cornwall, iu octahedral crystals, the primary form being a rhombic prism: the crystals are colourless and transparent, with a vitreous lustre. It is extremely rare.

FLUKE. [PLEURONECTIDÆ.]

FLUKE-WORM. [ENTOZOA.]

FLUOR. [FLUOR-SPAR.]

FLUOR-SPAR, Fluor, Fluate of Lime, Derbyshire Spar, is a well-known mineral, which occurs in many parts of the earth, but especially and in great plenty in Cornwall, Derbyshire, and Durham. It occurs both crystallised and massive. The primary form of the crystal is a cube, the cleavage is parallel to the planes of the regular octahedron, distinct, but seldom with perfect surfaces: it assumes a vast number of secondary forms, as the octahedron, rhombic dodecahedrou. The late W. Phillips mentious his possessing at least 70 heautiful varieties of foru, and he has figured a fragment of a crystal from Devonshire which, if it were perfect, would exhibit 322 planes. It occurs colourless, and of almost every colour, as gray, purple, black, brown, red, yellow, green, aud blue: in Derbyshire the last is the prevailing tint, and the massive Fluor of that county is termed by the miners 'Blue John.' It is frequently transparent, but more commonly ouly translucent; its lustre is vitreous. Specific gravity 3·14. Hardness 4·0. Streak white, or slightly coloured. Fracture conchoidal. When powdered and thrown on a hot coal, Fluor-Spar exhibits a phosphorescent light, which is blue, green, purple, or yellow; when thrown in mass into the fire, it decrepitates. The massive varieties are nodular or amorphous: the structure of the former is large fibrous, or columuar, with divergent fibres: tho structure of tbe amorphous variety is crystalline, granular, earthy, compact, and occasionally straight or curved laminar. The crystallised varieties are more common in Cornwall and the west of England; tho massive varieties in Derbyshire and tho north of England. It occurs in many places on the Continent also. In the United States of America a variety called *Chlorophane* is found at Huutington, Connecticut.

Fluorido of Calcium is found iu the teeth, in bones, and in the ashes of plants. It is used for obtaining Fluoric Acid, which is employed in etching. [FLUORIC ACID, in ARTS AND SC. DIV.]

Fluor-Spar is, strictly speaking, to ho considered as a Fluoride of Calcium, composed of—

One Equivalent of Fluorine	18
One Equivalent of Calcium . . .	20
Equivalent . . .	38

Tho blue and variegated Fluor-Spar of Derbyshire is turned into various ornamental forms, candlesticks, &c.; that of Cornwall is used as a flux in the reduction of copper-ore.

FLUSTRA. [CELLARIÆA.]

FLY, a name applied almost indiscriminately to all insects possessiug wings; by many however restricted to the various species of Dipterous Insects, an account of which is given under the head DIPTERA.

FLY-TRAP, VENUS'S. [DIONÆA.]

FLYING consists in the power which many animals possess of raising themselves in the air, and in moving through it in various directions, supported by tho atmosphere alone.

In the article SWIMMING it is shown that man and many of the lower animals are very nearly equal in weight to an equal hulk of river water; consequeutly a man's weight is very nearly or quite supported when he is immersed in water. But the case is widely different wheu he is in the air, as the density of this is to that of water very nearly as $1\frac{3}{8}$ to 1000; hence it follows that a man should he $\frac{1\frac{3}{8}}{1000}$ less in weight than he is at present, in order that he might he supported in the air with as little effort as he is in water. The physical constitution of the air is also very different from that of water, and presents other obstacles to the efforts of a man to raise himself in that medium.

The air is compressible, and consequently much heavier near tho surface of the earth than it is in the elevated regions of the atmosphere; and it appears from numerous experiments that as the height increases iu an arithmetical, the density decreases in a geometrical progression. Thus, supposing an animal to ascend in the air $3\frac{1}{2}$, 7, 14 miles, the density at the surface, being unity, would decrease iu the ratio of the numbers $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{16}$; so that if the animal were as light as the air itself at the surface of the earth it would continually increase in weight with respect to it as it ascended, and could not be supported unless a force equal to the difference between the weight of the animal and its owu bulk of air were properly applied for that purpose.

It appears from an elahorate investigation of M. Chabrier that tho quantity of force expended, if the weight of the body be called W, is proportioned to $\sqrt{W^3}$ directly, and inversely as the square root of the density of the air.

There are various methods of ascertaining that the air diminishes in weight as we ascend in it. We know that the barometer falls when taken to the top of an elevated hill; and it is owing to this circumstance that the barometer is used to measure the heights of mountains. The difference between the specific gravity of air and that of most animals is so great that there are but a few species amongst the whole range of the *Mammalia* that are capable of flying, and these possess very modified organs for that office.

Attempts have been made to construct mechanism that would enable man to propel himself in the air, and fly by means of his muscular movements. This however is not likely ever to be effected, in consequence of the great weight of his body with respect to that of the air which it displaces. We know that when adventurous persons have descended from the car of a balloon by means of a parachute the surface of the latter which is presented to the wind must be very great to prevent too rapid a descent. The unfortunate termination of the life of Mr. Cocking arose from his not having estimated more accurately the quantity of surface, and consequently the strength of material that was necessary to prevent his falling with too great velocity. Indeed we may dismiss the subject of a man attempting to fly by the application of his muscular force to any machinery at present known; but seeing how extremely difficult it is for any heavy body to be supported in the air, much more to fly, it must be a matter of curiosity at least to inquire into the means employed by animals which are naturally endowed with the power of flight.

Amongst the higher orders of *Mammalia* we find the Bats possessing the greatest power of flight. The figure of the Bat resembles in some degree that of a bird. In order to render it fit for aërial progression the body is small, and the bones of the skeleton are extremely light. The arms are long, and peculiarly constructed: the fore arm has its motion restricted to flexion and extension, and cannot rotate upon its long axis like that of a man. This gives the arm a much greater degree of firmness during flight. The hand moves outwards and inwards horizontally, in the same manner as that of birds, and cannot move upwards and downwards on the fore arm, which would weaken the force of the wing in flight.

Fig. 1.—Kalong Bat.

The wing of the bat instead of being clothed, and having its surface increased with feathers, is composed of a membranous expansion, passing from the neck to the tail. In order to increase the surface of the wing the bones of the fingers are very long; the thumb is not inclosed in the membrane, but lies in front of the wing, and terminates by a strong hook for prehension. In the Bat the area of the wings with respect to the weight of the body is very considerable. Indeed the surface exceeds that of many birds. The muscles which move the wings are extremely powerful, and these animals are enabled to keep on the wing during a period of many hours. They appear also to be endowed with an extraordinary and peculiar sensibility, and can fly through an intricate labyrinth even when deprived of sight. The velocity of some species of the Bat tribe is very great. They chase and capture the insects on which they prey whilst on the wing.

There are some other species of *Mammalia* said to be capable of flying, such as the *Galeopithecus*, or Flying Cat, and the *Pteromys Alpinus*, or Flying Squirrel, but the notion is entirely without foundation. They are certainly provided on each side with an expanded membrane, as seen in *fig.* 2, but these membranes have by no means the surface requisite to enable them to fly; neither are they capable of moving like the wings of birds. They may be useful as parachutes, to break their velocity of descent in falling or leaping from trees, but could never raise the body again from the ground into the air.

Fig. 2.—Flying Squirrel (*Pteromys Alpinus*).

Most Birds are capable of flight, but their facility of flying varies in different orders; and some, as the ostrich and cassowary, are devoid of the power of flight altogether; but this defect is compensated by their great speed in running. [RUNNING.]

In the Ostrich and Cassowary the wings are very small and the body extremely heavy, both which circumstances are unfavourable to flight; but in birds which are endowed with great velocity the converse of this is found, the body being very light and the surface of the wings large.

In order to adapt birds for flight the most refined mechanism has been bestowed upon them. The skeleton is extremely light, and the bones hollow and filled with air: the body is traversed by air-cavities. The figure of a bird is such as to present a very small amount of surface to the wind in the direction of its motion, so that during its flight the animal is retarded as little as possible by the resistance of the air. In birds of passage, such as woodcocks, &c., which are known to cross the sea 500 miles at one flight, Sir George Cayley found the length of the wing to be three and a half times that of its greatest transverse section. The feathers keep the body warm and tend to increase its surface without adding materially to its weight. The muscles which move the wings are very large and endowed with great power. In some birds they are capable of continued action during many successive days. The figure of the wing is nearly triangular, and the surface decreases as the distance increases from the shoulder joint, which is the axis on which the wing moves. (*Fig.* 3.) This figure of the wings is of great importance for rapid flight, as it enables the muscles to move them with greater velocity than they could do if the surface increased with the distance from the body of the bird. The wing is also concave below and convex above, so that the down stroke is much more effectual than the up stroke. The bones of the fore arm and fingers which support the wing are jointed, so that the wing unfolds itself outwards horizontally after it has been raised in the air, as in the Bats; and by these means the wing is prevented from yielding, both in the up and down stroke, to the resistance of the wind. The tail of the bird performs the office of a rudder, and tends by its elevation or depression to elevate or depress the head. The elevation of the tail raises the head, and vice versâ.

The mechanical effects of the tail have been demonstrated by Borelli, and also by Mr. Bishop in the 'Cyclopædia of Anatomy and Physiology,' article 'Motion.' The tail is also turned obliquely to alter the course of the bird, but the effects of this organ are not very powerful in directing its path to the right or left.

The number of flappings which any bird must make in order to fly depends on the weight of the bird, the surface of the wings, and the specific gravity of the atmosphere, the earth's gravity being supposed constant at all heights to which any bird ascends. In most of the smaller orders the wings move with very great rapidity, indeed far too great to enable us to count them by the eye. The wings of the diminutive and beautiful Humming-Bird oscillate with sufficient rapidity to emit a humming sound; hence its name. If we can be satisfied that it is the number of flappings of the wings which determines the pitch of the sound produced, we have a ready method of ascertaining the number made in a given time, because we can easily find in any work on acoustics how many oscillations are necessary to produce the required tone.

Fig. 3.—The Great Ibijau.

The velocity with which any bird moves depends on the number of flappings made by the wing in a unit of time, each flapping being supposed to constitute one elevation and one depression of the wing. It is estimated by M. Chabrier that the swallow expends as much force merely to sustain itself in the air as would be sufficient to raise its own weight 27·5 feet per second, and that its number of flappings is about 15 per second. This estimate of the number of flappings is however obviously greater than the bird employs; and notwithstanding all the care and attention which M. Chabrier has bestowed on the subject it is found that birds fly with much less expenditure of muscular force than would appear to be necessary by mathematical analysis.*

Fig. 4.—Humming-Bird.

The velocity of some birds is very considerable. It has been said that the Eider-Duck can fly 90 miles in an hour, and the Hawk 150 miles in the same time: there is however reason to suspect the accuracy of these accounts. With regard to the Pigeon the case is different. It is well known that these birds are trained to transmit intelligence on special occasions in which great speed is required; and their velocity has in consequence been more accurately taken. Some years ago two trained pigeons were started from Brighton at the same time: one arrived in London in 70 minutes, the other in 78 minutes. Now, if we estimate the distance traversed by the birds in question at 49 miles, it follows, by the rule of three, that the bird which accomplished the journey in 70 minutes travelled at the rate of 42 miles per hour, and the other at that of 38 miles; and it is probable that the former is about the maximum velocity of the Pigeon. It appears that in general pigeons make about 23 flappings of the wing in 5 seconds. The Rook, which has a large surface of wings, makes from about 10 to 15 effective strokes in a second.

Some birds, the Lark for instance, ascend vertically in a right line into the air to such heights as to become quite invisible, during which movement they pour out their well-known joyous song, so pleasing to the ear in consequence of its peculiar melody and purity of tone. The warbling of this bird is distinctly heard even when the little songster itself appears in the zenith (owing to its great altitude) as a mere speck.

"Hark! hark! the lark at Heaven's gate sings!"—*Cymbeline.*

When birds poise themselves in one position in the air, their wings oscillate in very small arcs compared with the arc through which they sweep when in rapid motion.

Many of the small, and indeed some of the larger birds, such for example as the Woodpecker, move from one place to another by a series of jerks, produced by three or four strokes of the wings made in rapid succession; immediately after which they close their wings, whilst the body is forced forwards like a projectile, in the path of a parabolic curve. Of all known birds the Great Condor of South America appears to have the greatest power on the wing. It is said to be capable of elevating sheep and other animals into the air, and of carrying them to the mountains to feed upon them at leisure. The greatest weight it is capable of supporting in the air is not accurately known, but it is doubtless very considerable.

Fishes being adapted by their structure to move and respire in the dense fluid of seas and rivers, are not constituted for flying. There appear to be only two species of fish endowed with the power of suspending themselves above the surface of the water; namely, the *Dactylopterus*, and the *Exocetus*, or Flying-Fish.

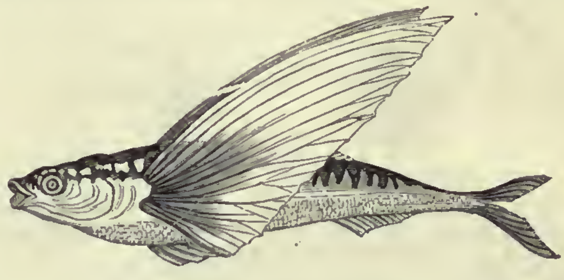


Fig. 5.—Flying-Fish (*Exocetus*).

In the *Exocetus* we observe that the pectoral fins assimilate very nearly in figure, situation, and dimensions to the wings of birds; and if, with the velocity and inclination of the latter, they possessed the power of oscillation, there seems to be no reason why they should not keep in the air as long as they could respire in that medium. But this does not appear to be the case. Their motions have been observed by Mr. Bennett, who states that he never saw them sustain themselves in the air for a longer period than about 30 seconds, and that they made no vibratory movements of the fins. According to Captain Basil Hall, their longest flight is about 200 yards; and they have been known to raise themselves as high as 20 feet above the surface of the water. From these statements an estimate may be made of the amount of force required to project the body into the air to such an amazing height and distance. At least it must be concluded that the muscular force employed is very great.

Amongst the numerous tribes of Insects, there are vast multitudes endowed with the power of flight. Now, although the mechanical principles on which this power depends are the same as those in birds, yet there is a considerable difference in the mechanism employed to effect their aërial progression.

The bodies of insects are traversed by air-tubes, which render them light and buoyant. The jointed structure of their frame enables the animal to curve, shorten, or elongate the body on itself. The wings present various forms (*fig.* 6, *a*, *b*, *c*, *d*, *e*, *f*), which exert a material influence on the velocity and mode of their flight. It is well known that some insects are provided with one pair of wings, and others with two. If we examine the surface of the wings, we perceive cords, which are composed of hollow tubes passing across the disc; these are called neuræ, and when filled with fluid, confer

* Sir George Cayley has estimated that a force equivalent to one-horse power (raising 550 lbs. one foot high in a second), if applied to appropriate machinery, would sustain 115 lbs. in the air. This however he considers only an approximate value, but perhaps not far from the truth.

on the wing strength and resistance, in the same manner as the cordage strengthens the sails of a ship. The wings are elevated and depressed by means of the expansion and contraction of the thorax, and are connected with the respiratory movements of the animal.

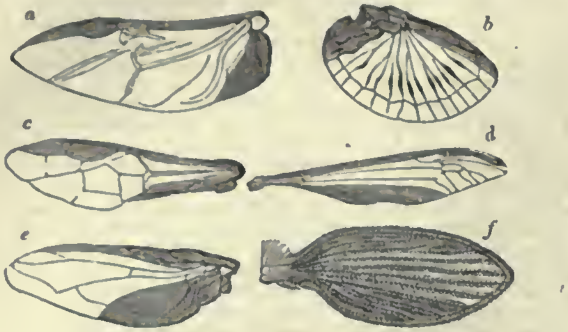


Fig. 6.—Wings of Insects.

a, wing of Beetle; *b*, wing of Earwig; *c*, wing of Saw-Fly; *d*, wing of Crane-Fly; *e*, wing of Common Fly; *f*, wing of Midge.

The *Diptera* have one pair of wings, which are elliptical in form, and connected with the mesothorax. Amongst the *Diptera*, we are familiar with the House-Fly, and the Blue-Bottle Fly. The former of these, it is well known, almost swarm in our houses, wherever sugar or ripe fruits are to be found. If an attempt be made to capture them by the hand, it is necessary that the movements should be made with the greatest rapidity in order to effect the object, as they are very watchful and agile.

The wings of the *Diptera* move far too rapidly to render it possible to count the number of strokes effected by them during flight. The House-Fly moves with considerable velocity; it is frequently observed to play round the ears of horses, when travelling at the rate of 10 or 12 miles an hour. The sound by which the flight of insects is accompanied does not arise, as is generally supposed, from the oscillations of the wing: if such were the case, there would be no difficulty in ascertaining the number of strokes.

The weight of the large Blue-Bottle Fly is less than one grain, and it has an area of wing amounting to about one-twelfth of a square inch, which is a much greater surface than is to be found in most other insects.

Fig. 7.—Humble-Bee.

Fig. 8.—Syrphus.

The *Diptera* are provided with two poisers, which are small bodies occupying the situation of the posterior wings of four-winged insects, and exert a considerable influence on their flight. It is said that if one poiser be cut off, the insect flies but a short distance with great difficulty, and then (one side being rendered lighter than the other) loses its balance, and falls to the ground. If both poisers be removed, it flies very unsteadily. The Crane-Fly makes use of its long legs to direct its movements in flight; the two anterior legs being directed forwards, and the posterior legs backwards. Mr. Kirby considers the former to represent the prow, and the latter the stern of a ship.

In those insects which are provided with four wings, the anterior pair are attached to the mesothorax, and the posterior pair to the metathorax. In the *Coleoptera*, the elytrum, or sheath must be elevated before the wings can be unfolded. The sheath adds weight to the insect, without contributing to aid its suspension in the air; indeed, in flying against the wind, the progress of the animal is rather retarded than accelerated by the sheath; but by the inclination of its surface the head is elevated so as to render the axis of the body nearly vertical during flight.

In the Stag-Beetle, the weight of the body is very great compared with the area of the wing, being about 40 grains to 1·25 square inch. In consequence of this disproportion, and the additional impediment of the elytra, the *Coleoptera* are unable to fly against a strong wind. Some entomologists maintain that none of the *Coleoptera* can fly against the wind, but Mr. Kirby confutes this opinion, and mentions a species (*Melolontha Hoplia*) which, he says, can fly in all directions.

The *Dermaptera*, such as the Earwigs, expand their wings like a fan. They take their flight generally towards the evening. The *Gryllus domesticus*, or House-Cricket, flies with an undulatory motion like the woodpecker.

The Diurnal *Lepidoptera*, or Butterflies, fly with a peculiar undulatory movement of the body, and have an enormous surface of wing compared with their weight. In the down stroke the two wings on each side lock together, producing by their combined action a greater effect. These wings spread out like a fan, and their surface rather increases than decreases as the distance from the axis on which the wings move increases. (*Fig.* 9). It is this form of wing and extent of motion, which produce the undulating flight to which allusion has already been made.

Fig. 9.—Butterflies (*Lepidoptera*).

Although in the Diurnal *Lepidoptera* the surface of the wings is so great with respect to the weight of the body, these insects do not fly with proportionate velocity; but are, nevertheless, endowed with sufficient speed to outstrip the schoolboy, when engaged in the chace of these beautiful insects.

The Nocturnal *Lepidoptera*, the Moths, possess considerable power of flight. The areas of their wings, instead of increasing with the distance from the axis of motion, decrease, as seen in *fig.* 10. They more nearly resemble the triangular figure of the wings of birds. The anterior wing is much larger than the posterior, but they act in unison with each other. The volume of the trunk of the Moths is usually much greater than that of the Diurnal *Lepidoptera*, and they fly with greater precision and velocity. Some species, the Silkworm-Moth for instance, is said to travel upwards of 100 miles a day.

Fig. 10.—Moths (*Lepidoptera*).

The Dragon-Fly affords a good example of the locomotive organs of the *Neuroptera*. They are furnished with four wings of a peculiarly delicate texture, the neura resembling net-work. (*Fig.* 11.) Unlike the *Lepidoptera*, the two wings on either side, being provided with a distinct set of muscles, act independently of each other, and are detached. The anterior and posterior wing are nearly equal in size, and the surface of the four wings, compared with the weight of the body, is greater than in *Coleoptera* and *Hymenoptera*. The velocity of the Dragon-Fly is very great, and necessary on account of its predaceous habits. They chase and capture the insect on which they feed with great ease, and the beauty and rapidity of their evolutions in the chace are worthy of attentive consideration. Leuwenhoek observed one of this tribe in a menagerie 200 feet in length, chased by a swallow. The insect flew with such velocity, and turned to the right and left in all directions so instantaneously, that the swallow, with all its powers of flight and tact in the chace, was unable to capture it ,the insect always keeping about 6 feet in advance of the bird. The wings are attached to the upper part of the body, about the centre of gravity, by which the animal is kept steady during flight.

Fig. 11.—Dragon Fly.

In the *Hymenoptera* (*fig.* 12), the ratio of the area of the four wings to the weight of the body is less than in the Dragon-Fly; and they are consequently obliged to make a far greater number of strokes in the same interval of time; because, both in birds and insects, when all other things remain the same, the number of strokes made by the wings will vary as the square root of the weight directly, and as the area of the wings inversely.

The area of the anterior and upper wings (*fig.* 7, *a*) is much greater than that of the posterior. The Humble-Bee has about 1-12th of a square inch of surface of wing to each grain weight of its body.

Fig. 12.—Bees and Snapdragon.

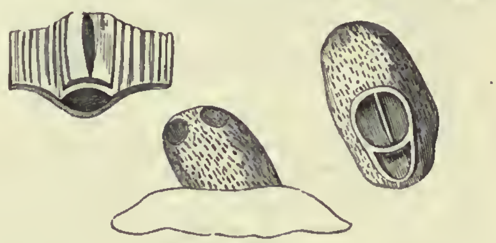
Bees are celebrated, not only for the geometric instinct which they display in the structure of their hexagonal cells so as to provide themselves with the greatest amount of room in the hive, whilst occupying the least possible space, but they are also known to fly between two distant points by the shortest road—that is, by the straight line. In consequence of the small amount of the surface of wing in the *Hymenoptera*, the Humble-Bee, Wasp, and Hornet, cannot fly with much speed against a strong wind; and in that direction the fleet schoolboy is enabled with ease to outstrip them. The *Ichneumoneæ* are provided with a larger surface of wing, as compared to the weight of the body, than the Bees.

The mechanism of the locomotive organs of birds and insects provides us with all the data necessary for the study of aërial progression. It affords ample proof that to render a man whose weight is 150 lbs., capable of supporting himself in the air by means of a pair of artificial wings, with the same facility as birds and insects, would require an extent of surface far beyond the control of his muscular force; and hence we conclude that the art of flying by means of muscular exertion, however applied, is denied to man.

FLYING-DRAGON, or FLYING-LIZARD. [DRACONINA.]

FLYING-FISH. [DACTYLOPTERUS; EXOCETUS.]

FO'DIA, a genus of *Mollusca* established by Bosc, and generally arranged by zoologists at the end of the simple Ascidians, and next to *Bipapillaria;* It is not better known than the last-named genus.



Fodia rubescens.

It has the following characters:—Animal oval, mammillated, divided throughout its length by a vertical partition, which contains the stomach, into two unequal tubes, opening at each extremity by an orifice, the upper one being a little sunk, and irregularly dentated, and the lower edged by a circular border forming a kind of sucker (ventouse), and serving to fix the animal.

Bosc founded the genus from a mollusk found on the coasts of North America.

FŒNI'CULUM, a genus of Exogenous Plants belonging to the natural order *Umbelliferæ*, to which the common herb called Fennel belongs. It was formerly considered a species of *Anethum*, but since the remodelling of the natural order *Apiaceæ* by Koch, it has been universally looked upon as a distinct genus. *Anethum* in fact belongs to the sub-division *Peucedaneæ*, with thin flat fruit, while *Fœniculum* forms part of *Seselineæ*, the fruit of which is tapering or very little compressed, and by no means flat.

F. vulgare, is a biennial plant with leaves cut into hair-like segments, yellow flowers, and glaucous stems. The fruit is ovate, not quite two lines long, pale bright-brown, smooth, the ridges sharp with but little space between each, the lateral ones rather the broadest, terminated by a permanent conical disc. Common on chalky cliffs in the southern parts of England, and everywhere cultivated for the sake of the agreeable aromatic quality of its leaves. Oil of fennel is obtained from the fruit.

F. dulce, the Finocchio Dolce of the Italians, is an annual sort which is cultivated in Italy as celery with us; and its blanched stems are said to be an excellent vegetable, resembling celery, but more tender and delicate, with a slight flavour of common fennel. The summers of England are not warm enough to render it possible to cultivate this successfully.

F. piperitum is a wild Fennel, occurring on dry elevated hills in Sicily, where it is called Finocchio d'Asino. It is known from Common Fennel by its long slender stem, short rigid leaves, and very hot biting fruit.

F. Panmorium is cultivated in various parts of Bengal, under the name of Panmuhuree, or Mudhoorika in Sanscrit. Its fruit has a warmish very sweet taste, and aromatic smell, and is much used by the natives with their betel and in their curries. The root is white, nearly fusiform, and almost simple; the stem is erect, branched from the base to the top, from 2 to 4 feet high, the branches erect, round, and smooth, with a uniform pale-glaucous tinge and not striated. The umbels are terminal, rather concave, but not regular; the flowers small, bright deep-yellow, the petals long, ovate, with their points rolled in. The stamens longer than the petals. The fruit is used medicinally in India as a warm aromatic and carminative.

F. Capense is a species little known, with a thick esculent aromatic root, found in the interior of the Cape of Good Hope.

F. tingetana is a native of Africa, in the province of Tangiers. It has a taper branched stem; the leaves are supra-decompound and shining; the segments oblong lanceolate, cut and toothed; the upper petioles large and sheathing. The umbel is terminal on a short stalk; the lateral flowers are few, the male on longer stalks. Sprengel considers this the

Silphion of the ancients, from which the *Laser Cyrenaicum*, or *Asa dulcis* was procured, but Viviani asserts that *F. tingetana* does not grow in the country of Cyrene, but only occurs more to the westward.

FŒTUS. [REPRODUCTION IN ANIMALS.]

FOOD. The materials taken into the system of organised beings, and by which their functions are maintained, and out of which their bodies are formed, are called Food. Food in its widest sense is the raw material out of which plants and animals are manufactured. We shall confine ourselves here to the consideration of the food of animals, and of man in particular.

The great cause of the necessity of a constant supply of new matter or food to the body is the waste of the materials of which the blood and organs are composed, during the performance of their functions. The result of this waste is seen in the form of the various excretions which are thrown off from the body by the skin, liver, kidneys, and bowels. We shall find, then, that the food, the blood, and the excretions, represent each other, that they contain substances of the same nature, and are all composed of the same ultimate elements.

If we take a portion of human flesh or blood, and seek for its ultimate elements, we shall find that, on accurate analysis, they will yield the following elements:—

Carbon.	Potassium.	Aluminum.
Hydrogen.	Sodium.	Copper.
Nitrogen.	Calcium.	Chlorine.
Oxygen.	Magnesium.	Fluorine.
Sulphur.	Iron.	Silicon.
Phosphorus.	Manganese.	

Few or none of these elements occur in the human body in their pure form, but are combined variously with one another, forming compounds having very different physical properties and chemical relations. These elements may be divided, for physiological purposes, into two classes; the first four, carbon, hydrogen, oxygen, and nitrogen, being called Organic, whilst the remainder are called Inorganic elements. The first are called organic elements because they are found universally present in plants and animals, and because no animal cell and no vegetable cell can grow unless the whole of these elements exist. Hence, as they lie at the foundation of all organic existence, they are properly designated by this term.

The inorganic elements, though very generally present in large classes of animals and plants, are not universal. Man requires phosphorus and calcium in the form of phosphate of lime for his bones; but many of the lower animals contain no phosphate of lime. Sea-animals and plants will not live without chlorine and sodium in the form of common salt; but fresh-water plants, and plants away from the sea-shore, do not require this constituent. The term inorganic, then, is applied to these elements to express their different relation to plants and animals, and will also point out their frequent occurrence in the mineral world. The elements of man's body however are all derived from the mineral world, and are identical with the same bodies in inorganic substances. The carbon found in the human body is identical with that which forms, in its pure state, the diamond —which enters into the composition of graphite and various kinds of coal, and is found in limestone and chalk, forming a part of the carbonic acid of the carbonate of lime, of which these rocks are composed. The hydrogen of the human body is the same as the gas which, united with oxygen, forms water, and when combined with nitrogen produces ammonia. The oxygen of the animal is identical with the gas which, with nitrogen, forms a fifth part of the atmosphere, and which, combined with the metals, forms oxides, of which the greater portion of the earth's surface is composed. The nitrogen of the organic world is identical with that which constitutes so large a portion of the atmosphere. Nor are these elements alone identical in and out of the human body; but we find that they possess the same chemical properties, and that their agency in the human body depends on these properties. Thus, carbon and hydrogen are inflammable bodies, and have a great affinity for oxygen, with which they unite, forming carbonic acid and water, giving out heat during the process of union. This very process goes on in the animal body, and constitutes one of the most important functions of the body. The characteristic features of the functions and properties of animal and vegetable bodies depend on the chemical relations of the four organic elements.

These elements never enter the system in their pure form. Carbon, however needed in the animal frame, cannot be appropriated pure; and a man would starve with the Koh-i-noor diamond in his mouth, were he not allowed to exchange it for more digestible forms of carbon. The gases hydrogen, oxygen, and nitrogen, would, any one of them in their pure state, destroy human life; and even when the two last are mixed with the atmosphere, they will not support life in that form. Again, we may mix them in various ways, and not be more successful. Carbon combines with oxygen to form carbonic acid, and hydrogen combines with nitrogen to form ammonia, and these two compounds unite together to form common smelling-salts, or carbonate of ammonia. But smelling-salts, though they contain all the organic elements, will not serve for human food. Nevertheless what is not food for man is nutriment for plants. Carbonic acid and ammonia supply plants with materials of growth. It is from these two bodies that the vegetable kingdom elaborates all the secretions which give to plants elegance of form, beauty of colour, deliciousness of scent, deadliness as poisons, and nutritiousness as food. The plant stands between the mineral and animal kingdoms, preparing the former for the service of the latter. Without plants there could be no animals. In the whole range of natural history we are presented with no instance of an animal existing directly on mineral matter. It is true that many animals are carnivorous, and live on the flesh of lower animals. The lion and the tiger prey upon the deer and the antelope; but if we go one step further we still arrive at the vegetable kingdom as the source of animal nutrition. The deer and the antelope are herbivorous creatures, and the flesh of their body is formed directly from the plants they eat. So with the animals eaten by man; they are all grain or herb-eating animals, and supply to man the materials they have obtained from the vegetable kingdom. At the same time the best standard we can take of food is milk, which is derived from the animal. When human milk is examined, it gives the following results in every 1000 parts:—

Water	870
Butter	52
Sugar	63
Casein	10
Salts	5
	——1000

These five constituents of milk may be regarded as typical of all kinds of food, whether obtained from the animal or vegetable kingdom. Hence, we may class alimentary substances according as they are represented by one or other of these constituents of milk.

1. *Aqueous.* Water is required not only as the medium of conveying the other substances into the body, but it forms a prominent constituent of the body itself. Blood contains 790 parts of water to 210 parts of solid matter in every 1000. Muscles contain 770 parts of water to 230 parts of solid ingredients. The brain and nerves contain about 800 parts of water in 1000. If food does not contain water naturally, it is taken into the system in the form of tea, coffee, beer, and also in its pure state. The quantity of water taken with the food should be about in the proportion of four to one, as we find it in milk. We cannot however judge of the quantity contained in solid food till we know its composition. Thus many substances which appear solid contain large quantities of water. In potatoes, for instance, there are 75 parts of water in every 100.

2. *Oleaginous.* The butter of the milk represents oily and fatty matters in general, which seem to enter into the composition of all healthy food. They are taken by the inhabitants of tropical countries in the seed of the cocoa-nut, as well as by those of the polar regions from the fat of the seal and many kinds of fish. They are obtained from both the animal and vegetable kingdoms, being known by the name of suets, fats, and lards, from the former source; and oils and butter from the latter.

3. *Saccharine.* The sugar of the milk represents several substances obtained from plants and used as food. Sugar itself varies in its composition according to its sources; hence we have cane-sugar, grape-sugar, maple-sugar, &c. Sugar has also a composition nearly approaching that of starch, and this substance is very generally found in the vegetable diet of man; pure in the form of arrow-root, tapioca, and sago; combined in the flour of wheat and other cereal grasses. Of all the animal products used as food, sugar is found alone in milk.

4. *Proteinaceous.* The casein of the milk, which, when separated, is known by the name of cheese, has, in common with two other vegetable and animal substances, called fibrine and albumen, a principle for their basis named protein. [PROTEIN.] These substances form the chief part of the fabric of the body, and in their capacity of food perform a very different function in the body to the butter and sugar before mentioned.

5. *Inorganic.* The salts of milk are the saline substances which, entering into the composition of various parts of the human body, are necessary to its integrity and health. The importance of the presence of those substances is frequently overlooked in food, and many diseases of the human frame arise from their absence. They are conveyed into the system in both animal and vegetable food; but in common salt we have an instance of a substance belonging to this class taken directly from the mineral kingdom as food without the intervention of an organic body.

In addition to these forms of dietetic substances found in milk, the food of the adult human being constantly contains certain principles which do not appear to be represented in the milk. Thus, the substances called condiments, as the various spices, contain volatile oils, which, although not essential to the diet of man, seem to exert a very beneficial influence when taken into the system. In tea and coffee there is a principle called theine, which seems to be the active ingredient of these substances. In the fruit of plants also, we have acids, as the citric, tartaric, malic, and oxalic acids, which seem to act very beneficially in certain states of the system. As these substances seem to act medicinally rather than dietetically, they may be properly called, as a class, the medicinal constituents of food. The following classification will give an idea of the kinds of food:—

Class I. *Alimentary Substances.*

Group A. *Aqueous*, containing water as a principal ingredient. Examples:—Tea, coffee, beer, wine.

Group B. *Carbonaceous*, containing carbon as a distinguishing ingredient.
1. *Saccharine.* Examples:—Sugar, starch, cellulose.
2. *Oleaginous.* Examples:—Oil, butter, fat.

Group C. *Nitrogenous*, containing nitrogen as a distinguishing feature.
1. *Vegetable.* Examples:—Flour, oatmeal, maize.
2. *Animal.* Examples:—Butcher's meat, cheese.

Group D. *Inorganic.*
1. From organic sources. Examples:—Potash in fresh vegetables, phosphate of lime in flour and flesh.
2. From the mineral kingdom. Example:—Common salt.

Class II. *Medicinal Substances.*

Group A. *Acids.* Examples:—Citric acid in oranges, tartaric acid in grapes, oxalic acids in rhubarb-leaves.

Group B. *Volatile Oils.* Examples:—Mustard, pepper, nutmeg, cloves.

Group C. *Alkaloids.* Examples:—Theine in tea and coffee, theobromine in chocolate.

We shall here make a few general remarks on the nature of the substances in the groups indicated, referring for special information on the plants and animals yielding food to the various articles devoted to these subjects throughout the 'English Cyclopædia.'

Under the head of WATERS, MINERAL, will be found an account of Water and the substances it usually holds in solution. In taking it as an article of diet, the following general remarks should be borne in mind:—

First, It may be taken in too large quantities to be carried off by the other emunctories, and then it remains in the system to impoverish the blood, and to reduce the amount of solid matter that is necessary for the performance of the functions of the tissues of the body. This is one of the results that take place from what is called the 'water cure.' Unless persons have sufficient vigour to take the exercise necessary to throw off by the skin the water that is taken into the stomach, serious ill effects must necessarily arise. The good that is effected by this system of the treatment of disease must be attributed more to the exercise it renders necessary than to the unnatural quantities of water taken into the system.

Secondly, Water may not be taken in sufficient quantities to carry on the healthy functions of the system. If the food is taken too dry, it is only imperfectly digested, and many important constituents, such as the salts, are not taken into the body in sufficient quantity. A deficient quantity of water in the blood will also prevent the healthy process of nutrition, and wasting and degeneration of the solid parts of the body will occur. It would be difficult, perhaps, to lay down any law with regard to the quantity of water individuals should take, and perhaps it is safer to rely on the instincts of the body, which seem to point out how much we ought to take by the feeling of satiety that comes on after enough has been taken. We may however get at something like an approximation of the proportion of solids and fluids required by the system in food, by examining the composition of milk, in which we find the proportion of water to solid parts is as 870 to 130 in 1000 parts, or about as seven to one.

Thirdly, The good effects of water may be destroyed by the substances with which it is taken. Although the stomach has the power of separating water from the food in which it exists, it yet often happens that the fluid articles of diet are injurious. Water itself may contain so large a quantity of saline matters, or of organic matters in a state of decomposition, as to cause serious disease. The taking habitually water in the form of fermented liquors, as beer and wine, as also the admixture of distilled spirits, may cause irritation and congestion of the mucous membranes, and derangement of the nervous system.

We now proceed to speak of the Carbonaceous Group. This class of substances is sometimes called Respiratory and Combustible. They are called respiratory because it is through the function of respiration that they become useful in the system. They are called combustible because it is through the process of combustion that their effects upon the system are developed. This class of foods does not, in fact, contribute directly to the nutrition of the body, but they are consumed in maintaining the animal heat. The temperature of the human body is always a fixed one; and if we place a thermometer upon the tongue, or under the arm, or in any other unexposed part of the body, we shall find that it stands at the point in the index of Fahrenheit's thermometer marked 98°. [HEAT, ANIMAL.] This heat the human body maintains equally at the poles and under the tropics. No external temperature alters it, and we have thus conclusive evidence that it is produced from within. The cause of this heat is the combustion of the carbon and hydrogen contained in the carbonaceous group of foods. Starch, sugar, and oil are conveyed from the stomach into the blood, and whilst in the blood they are brought in contact with oxygen gas, which is taken in during respiration, and the consequence of this contact is the union of the carbon and the hydrogen with the oxygen, the formation of carbonic acid gas and water, and the giving out of heat.

The human body is preserved at the same temperature by the regulating action of the skin. When large quantities of heat are generated in the body, by exercise or other causes, then the extra heat is carried off by the perspiration from the skin; but when the body is exposed to a low temperature, and its heat is rapidly conducted away by surrounding cold, the heat is maintained by increased supplies of food belonging to the carbonaceous group. The animal heat of the lower animals varies according to the circumstances of the creature. Those performing great muscular exertions, and living in cold climates, have a higher temperature than man; whilst those which are not active in their habits, and live in hot climates, have a temperature lower than that of man.

The substances belonging to this group which enter into the food of man are cellulose, starch, sugar, and oil.

Cellulose forming the external membrane of the cells of all plants is found in all food derived from the vegetable kingdom. It has a composition almost identical with starch, but differs in being insoluble and indiffusible in water. There can be little doubt however that it is taken up extensively into the system in the food of the lower animals, especially of the *Herbivora.* When cells are very thick with cellulose they are indigestible, and this will account for many articles of food as carrots, turnips, radishes, uncooked vegetables, &c., not being readily digested. Cellulose is converted into starch by the addition of sulphuric acid, and it is not improbable that some change of this sort may take place when it is taken into the stomach. It is however seldom taken by human beings alone, although recommended by no less an authority than Benjamin Franklin, who showed by example that saw-dust puddings might be used as an article of diet.

Starch enters very largely into the diet of man, and of the lower animals. It is distinguished from cellulose by its ready diffusibility in water. [SECRETIONS, VEGETABLE.] On this account it appears to be much more readily absorbed from the stomach or converted into the forms in which food is taken up into the system. Its property of uniting with water and forming with it at a high temperature a gelatinous mass, explains the change which takes place in boiling the flour of the grains in which it is contained.

Starch is found in some plants in greater quantities than in others; it is however very generally found in perennial roots and rootstocks, in the stems and in the seeds of plants. There are few or no vegetables or parts of plants that are eaten that do not contain starch. It is found in turnips, carrots, potatoes, cabbages, parsnips, beans, peas, wheat, barley, oats, and the rest of the *Cerealia;* in chestnuts, walnuts, hazel-nuts, and all other seeds; in the apple, the pear, the plum, and cherry, and all other fruits. In many of these things however it is not the distinguishing alimentary ingredient, but it is often separated, and is used pure as an article of diet. The substances in which it occurs pure are arrow-root, sago, and tapioca.

What is sold under the name of arrow-root in the shops, is a form of starch procured from the rootstocks of various species of plants belonging to the family *Marantaceæ.* There are three kinds of arrow-root known in the shops, the West Indian and the East Indian arrow-roots, and Tous les Mois. [MARANTA.]

Although there is much difference in the price of arrow-root, its composition is always the same. Even the substances used to adulterate arrow-root, as potato and sago starch, are of the same composition; and though the appearance and flavour of the arrow-root may be impaired, its ultimate dietetical action is the same.

Although arrow-root, sago, tapioca, and potato starch, are all composed of the same constituent, their flavour is very different; hence the preference given to arrow-root as an article of diet. This flavour depends on some peculiar principle which is produced in the plant from which the starch is obtained, and by very careful preparing can be entirely got rid of. Arrow-root is used for making cakes, puddings, and a thick gelatinous fluid in great request in the sick room. It is a property of starch to combine with water at a temperature of 180°, and form a gelatinous compound. This property of starch renders it very useful in cookery, and seems to increase the digestibility of the starch itself.

Arrow-root is frequently regarded as nutritious; but it will be seen that it is not nutritious in the proper sense of that word. Those foods can alone be called nutritious that contribute to the building up of the fabric of the body by adding those materials to the tissues which are being constantly removed by the wear of the body. Now starch does not perform this function, and is entirely consumed in the body in maintaining its animal heat. Arrow-root however and the other forms of starch, are frequently mixed with nutritious matters, such as milk and bread; and in this way the food into which they enter becomes nutritious.

Another form of starch is Sago. It is starch obtained from the inside of the trunks of palms, and other trees. Many plants yield starch in their stems, which, on being prepared, is called sago by Europeans. The sago which is sold in the shops of England is principally imported from the islands of the Indian Archipelago, and is the produce of a palm called the true Sago-Palm, or *Sagus lævis.* There is however another palm belonging to the same genus, the *S. Rumphii* (the Prickly Sago-Palm), which yields the sago that is consumed by the natives of India.

Sago is not generally so carefully prepared as arrow-root, and it is a much cheaper article of diet. Its ultimate action is perfectly the same as arrow-root. It is now often employed by starch-makers to procure the finer kinds of starch used by manufacturers. When thus prepared, it is used to adulterate arrow-root.

Tapioca is another form of starch. It is brought to Europe from South America, and is the produce of a plant known to botanists by the name of *Denipha Manihot*. It is a poisonous plant, and the Indians in the countries where it grows extract a poison from it, which they use to poison their arrows, before they obtain the starch. Cassava, which is eaten by the natives, is procured from the same plant, but is prepared in a different way from tapioca. The starch of tapioca does not differ in chemical composition from that of sago and arrow-root, and it is used in the same way, and for the same purposes.

An Indian family preparing Tapioca. The woman is poisoning an arrow with the juice which exudes from the bag containing the Tapioca.

There are many other well-known plants which owe their dietetical properties to the starch they contain; amongst these we may mention the potato, the carrot, the turnip, the parsnip, the cabbage, the Jerusalem artichoke. From any of these starch might be prepared. The roots of *Arum maculatum*, though acrid, contain much starch. When cooked, the acridity of the plant is got rid of, and they are eaten with impunity. These roots are employed in making the substance called Portland sago, which is the starch separated from the rest of the matter of the plant. This sago is used for the same purposes as the other kinds of sago.

The roots of *Orchis mascula*, which is a common plant of our meadows, form the substance called salep. When it is boiled, it forms an agreeable article of diet, which, before the introduction of tea and coffee, was very generally used in this country. It is now almost entirely disused in Great Britain.

Starch differs in some of its chemical and physical properties according to the plants whence it is obtained. In this way chemists have distinguished several kinds of starch. Inuline is a form of starch obtained from the *Inula Helenium*, a plant not uncommon in our own fields. [INULA.] Lichen-starch is another form, which is found in almost all kinds of *Algæ* as well as Lichens. This starch has the same power of thickening water at a high temperature as arrow-root and tapioca; and hence, when any of these plants are boiled in water, they form a thick mucilaginous decoction. The thickness of the fluid thus obtained, under the erroneous notion of its being nutritious, has led to the use of many species of sea-weeds and lichens as articles of diet.

One of the plants of this kind, which has been used most extensively and is still largely employed, is the Iceland-Moss (*Cetraria Islandica*). It belongs to the family of Lichens, and is a native of the northern parts of the world. This and other lichens probably contain other dietetical secretions besides starch, as we find they are capable of supporting animal life. The Rein-Deer-Moss (*Cenomyce rangiferina*) is an instance of this. In the northern parts of the world as well as in mountainous districts this lichen grows in great abundance, and during the winter season is the principal support of the rein-deer. In spite of the extreme cold to which it is subjected this plant grows with vigour, and the rein-deer, in order to obtain it as food, is obliged to remove with its nose the snow with which it is sometimes covered for many feet. The Cup-Moss (*Cenomyce pyxidata*) of our own moors belongs to the same genus as the rein-deer-moss, and is also used as an article of diet in the same way as the Iceland-moss. The Tripe de Roche is another of these lichens which has been used as an article of diet. It has a melancholy interest attached to it, as it has so often formed the chief article of diet of our arctic navigators. Two species of lichens, the *Gyrophora proboscidea* and *G. erosa*, afford the Tripe de Roche. Although they are said to be nutritious, they are described as having bitter, nauseous, and purgative properties.

Amongst the sea-weeds which have been used as articles of diet none is better known than the *Chondrus crispus*, which under the name of Carrageen-Moss, Irish Moss, and Pearl-Moss has been for a long time used in Europe. [ALGÆ.] It grows on the rocky sea-shores of Europe; and when washed and dried, and then boiled with water, makes a mucilaginous decoction, which, like the same preparation of the Iceland-moss, has been recommended in consumption, coughs, diarrhœa, and other diseases. It has however no bitter principle, and is probably less tonic than the lichen. This and other sea-weeds have been occasionally had recourse to by the poor inhabitants of the sea-shores of Europe, more especially Ireland, when the ordinary corn or potato crop has failed. They contain however but little nutritious matter, and persons soon famish who live upon nothing else. There are certain forms of sea-weed which are often eaten as an addition to other kinds of food. There is in all of them a certain flavour of the sea, arising probably from the saline matter they contain, which renders them very objectionable to some persons as articles of food, and which will probably always form an objection to their general use. Of those which are eaten in various parts of England we may mention:—

1. Laver, Sloke, Slokam (*Porphyra laciniata*). It is on all our sea-shores; and when employed as food is salted and eaten with pepper, vinegar, and oil.

2. Green Laver, Green Sloke, Oyster-Green (*Ulva latissima*). The *Ulva* is not so good to eat as the *Porphyra*, and is only had recourse to when the latter is not abundant.

3. Tangle, Sea-Ware, Sea-Girdles, Sea-Wand, Red Ware (*Laminaria digitata*). It is cooked by boiling for a long time, and adding pepper, butter, and lemon-juice. Cattle are fed on it when young in some parts of the British Islands.

4. Badderlochs, Hen-Ware, Honey-Ware, Murlins (*Alaria esculenta*). The part of the plant which is eaten is the thick middle rib which runs through the frond. It is sometimes called the Eatable Fucus.

5. The Dulse of the south-west of England is the *Iridea edulis* of botanists. It is eaten by the fishermen of the south-west coasts of England, who before eating it pinch it between red-hot irons. In Scotland it is cooked in the frying-pan. It is said to resemble in its flavour roasted oysters.

6. Dulse of the Scotch, Dellisk, Dellish, Duileisg, Water-Leaf (*Rhodomenia palmata*). The Highlanders and the Irish, before the introduction of tobacco, were in the habit of drying this weed and using it as a masticatory. The Icelanders use it as an article of diet under the name of the Sugar-Fucus. In the islands of the Mediterranean Archipelago it is employed as an ingredient to flavour soups, ragouts, and other dishes.

Several other sea-weeds have been employed as food, but these are the principal that are at present used in this country. In China the people are very fond of sea-weeds, and many kinds are collected and added to soups, or are eaten alone with sauce. One of these, the *Plocaria tenax*, is sometimes brought to this country under the name of Chinese Moss. The decoction it makes is so thick that it is used as glue. The Corsican Moss, which has a reputation in medicine as well as a diet, is the *Plocaria Helminthocortos*, and is found on the coasts of the Mediterranean. Another sea-weed was recently imported into London under the name of Australian Moss; but although affording a very thick jelly, it tastes too strongly of the sea to be rendered pleasant by any kind of cooking.

The next dietetical substance of which we have to speak is Sugar. Sugar is distinguished readily from starch by many properties. Sugar is soluble in water, whilst starch is only diffusible through it. Sugar is susceptible of fermentation, and of being converted into alcohol, which starch is not. Sugar has a peculiar sweet taste, whilst starch is insipid. It is on account of the solubility of sugar that we never, or very seldom, find it in plants in a solid condition. It is always dissolved in the water naturally contained in the plants in which it exists. Sugar is not so frequent a product of vegetable change as starch; but is, nevertheless, very generally found during some period of the growth of the majority of plants. [SUGAR.]

Sugar, like starch, is not nutritious, but is taken into the system with the object of maintaining animal heat. Persons may even get fat on sugar, but the living tissues are not nourished by any of the carbonaceous productions of plants. It is true, that in countries where the sugar-cane is grown, slaves and their children, during the period of its gathering, partake of it in large quantities, and are nourished upon it; but the sap of the sugar-cane, and the cane itself, contain other alimentary principles besides sugar, which assist in the uutrition of the body.

Sugar, being readily soluble in water, is more digestible than starch. Of the substances which maintain animal heat, it is the most easily digested; and hence we may see a reason why it is supplied to the young of the higher forms of animals. For this purpose it is secreted, by the female of all the *Mammalia*, in the milk, which is furnished universally to their young during the first months of their existence. The instinctive love of sugar, so well known as a distinguishing character of the child, seems to point out its adaptation to the wants of the infant system. Readily digestible however as sugar is, it is one of those substances which speedily undergoes decomposition. When taken into the stomach and the system, its elements seem to enter into secondary combinations, which are very injurious. This is why so many persons find it necessary to limit the quantity of sugar which they take in their diet. The changes however which it so frequently undergoes in tho adult system, do not appear to take place in children; hence the child may eat sugar with impunity, although its parents may not.

Although there are various kinds of sugar, having a different compositiou, they seem all to act dietetically in the same way upon the system. The most common form of sugar in plants, and that which is most frequently eaten in diet, is Cane-Sugar, so called from its being yielded by the sugar-cane. It consiste of—

	Atoms.
Carbon	12
Hydrogen	9
Oxygen	9
Water	2

The other kinds of sugar which are eaten, are milk-sugar, $C_{24}H_{19}O_{19}+5HO$; and grape-sugar, $C_{12}H_{12}O_{12}+2HO$. It will be seen that cane-sugar resembles starch in its composition, and it is probably formed in the plant from that body. Although cane-sugar is found in the sugar-cane, the beet, and the maple, it is not so frequent in plants as grape-sugar, which is the form in which sugar is found in the fruits and other parts of plants which may be sweet.

The sources of sugar, as an article of diet, are of course very various; it is only separated however from a limited number of plants. Of these the principal is the sugar-cane (*Saccharum officinarum*).

The sugar eaten by the inhabitants of Franco is principally obtained from the Beet (*Beta vulgaris*). In tropical countries it is obtained from the juice of palms, as from the Jaggary Palm (*Caryota urens*), the Cocoa-Nut Palm (*Cocos nucifera*), and others. It exists in the stems of all grasses, and is prepared in America from Maize (*Zea Mays*). The Birch (*Betula alba*) in this country, and the Sugar-Maple in America (*Acer saccharinum*), also yield it in their sap.

Grape-sugar, also called Glucose, is found in the fruits of most plants. It seems to act on the system in precisely tho samo way as cane-sugar.

The result of the fermentation of grape-sugar is the production of Alcohol, which does not differ much in composition from sugar. The following is the decomposition:—

	C.	H.	O.
2 Atoms of Alcohol	8	12	4
4 Atoms of Carbonic Acid	4	0	8
2 Atoms of Water	0	2	2
One Atom of Grape-Sugar	12	14	14

Alcohol is taken as an article of diet in the form of beers, wines, and spirits. Although resembling sugar in its composition, its effects on the system are very different. It acts on the nervous system as a stimulant and narcotic, and might perhaps be regarded as ono of the medicinal forms of food. A question has arisen amongst physiologists as to the action of this substance on the system. Liebig, and with him many others, maintain that like starch and sugar and oil, the elements of the alcohol unite with oxygen in the system, and thus by combustion assist in maintaining animal heat. On tho other hand Dr. Carpenter, and those who repudiate the use of alcohol in diet, maintain that it is not destroyed during respiration, and consequently does not promote animal heat any further than as it stimulates the heart's action.

Alcohol when taken as an article of diet not only acts upon the nervous system, but on account of its chemical action on albumen exerts an injurious influence when taken in large quantities upon the mucous membrane of the stomach. It is thus that when indulged in, it becomes a source of indigestion, and lays the foundation of serious diseases. Taken in small quantities in the form of wine or beer, it seems to exert a favourable influence on the digestive function, and to belong to that class of foods to which spices and condiments are referred. Taken medicinally it is often capable of exerting powerful effects, on account of its rousing action upon the vascular system. It does not seem to be necessary to health, as there are many nations that never use it, and individuals, in countries where it is habitually taken as an article of diet, find their health not materially injured by debarring themselves from its use.

The quantity of alcohol contained in fermented beverages varies very much.

With regard to wines, when the juice of the grape contains large quantities of sugar in comparison with the water, and the fermentation is complete, then the alcohol is abundant, and strong wines are produced; whilst, when the sugar is in small quantities, or the fermentation is incomplete, weak or thin wines are the result. Ports and sherries are strong wines, whilst those of the Rhine are generally weak.

Sweet wines are those in which all the sugar is not converted into alcohol. This is mostly the case with wines made from other fruits besides grapes. Hence the well-known sweetness of what are called British wines. This does not however arise from an imperfect fermentation, but from the acid contained in other fruits not being tartaric acid. One of the most remarkable properties of tartaric acid is that it forms an insoluble salt (the cream of tartar) with potash, which is generally found in fruits; and in wines made from the grape this salt falls to the bottom of the cask, forming the tartar or lees of the wine. But other acids, as citric, malic, and oxalic acids, are not thus precipitated from their solutions, and they remain in wines, giving them a very acid flavour, which would render them unpleasant, unless sugar was added to cover their acidity. Sweet wines are objectionable as articles of diet, on account of the sugar they contain, which, when held in solution in wine, seems more likely to decompose, and thus prove injurious to tho system, than when taken in its pure form. In wines made from other fruits besides grapes, the acid is also liable to objection.

Effervescing wines are those which are bottled before the fermentation is complete, so that a large quantity of the carbonic acid, which would be otherwise got rid of, is retained in solution in the wine, and escapes when the bottle is uncorked. Such is champagne. Effervescing wines are more liable to disagree with delicate stomachs than others, on account of their imperfect fermentation rendering them liable to further change in the stomach; and this state of change is probably communicated to the substances used as food contained in the stomach.

The skins and stalks of the grapes, if not the juice, contain tannin. This substance is a powerful astringent, and its presence seems to be tho cause of the astringent character of many red wines, as port, claret, and others. There is also a difference in the quantity of free tartaric acid contained in wines; and those which have the largest proportion of this constituent have an acid flavour. Some of the wines made from grapes are so sour as to be very unpalatable: this is more especially the case with the poorer white wines of the Rhine.

The quality in which wines differ from each other most is what is called their bouquet, or flavour. It differs in wines made from different kinds of grapes, and differs in the same grape in different districts and in different seasons. It is well known that the vintage of one year produces a better or worse wine than that of another, and this depends on the development of the peculiar flavour of the wine. Liebig says that the bouquet is dependent on an acid which he calls œnanthic, and which, combining with the alcohol, forms an ether which gives the odour and flavour to wines.

The quantity of alcohol contained in wines differs very much. The ports and sherries consumed in England contain the largest quantity. But then much of this is added. It is added in the form of brandy. Brandied wines keep best, but are not the best to drink. Unless wines are naturally strong, they will not keep without the addition of alcohol. Clarets, hocks, and Moselles, are seldom brandied. Some of the hocks do not contain more than seven per cent. of alcohol, whilst port and sherry contain twenty-five per cent.

Ardent spirits, distilled liquors, differ from wine in their having been submitted to distillation after the fermentation, which produces the alcohol. Brandy is distilled from wine; and peach-kernels, or other vegetable matter containing oil of bitter almonds, are added to give it a flavour. All the parts of the plants belonging to the division of the order *Rosaceæ*, called *Amygdaleæ*, contain oil of bitter almonds. Rum is distilled from molasses or treacle in the West India Islands, and pine-apples are added to give a peculiar flavour. Gin is distilled in Holland, from rye; in this country from wheat, the grains of which are allowed to become saccharine, and then fermented. Juniper berries are employed to give the peculiar flavour to gin. Whiskey is distilled from wheat, barley, or oats, treated in the same manner as for gin. Nothing is added to flavour it; but the smoke of the peat, by the aid of which the distillation is effected in both Ireland and Scotland, gives a characteristic flavour to this liquor. Liqueurs belong to this division; they aro distilled spirits containing large quantities of sugar, and are flavoured with all kinds of substances, as celery, bitter almonds, gentian, wormwood, &c.

Beers, Ales, and Porters, differ from wines in the addition of a bitter principle, most frequently the hop, to the fermented liquor. The saccharine matter for fermentation is obtained through barley. The grain of barley is steeped in water, and allowed to germinate. When the starch of the grain is converted into sugar, it is submitted to heat, and malt is formed. The malt is placed in boiling water, and hops added; when cooled, the process of fermentation is allowed to take place, and the beer is completed. When the malt is slightly charred during the process of drying, it gives a dark colour to the beer. It is then called porter. These fluids vary much in strength and bitterness, according to the quantity of malt and hops employed.

Beer is the safest of these beverages for habitual use; but even this may be indulged in too freely, and disease may be the result. Of the various kinds of beer, that which is to be most commended, is the weak form of bitter ale, which is now so generally employed in the households of London and its neighbourhood. Beer acts as a tonic on account of its bitter principle, as well as a stimulant, and is frequently, on this account, found to be a valuable addition to the ordinary diet.

The Oleaginous Group of foods is somewhat peculiar. They are taken in various forms from both the vegetable and animal kingdoms, and are known under the name of butter, oil, lard, suet, fat, &c. The following formula will express the composition of this class of bodies:—

Carbon	11
Hydrogen	10
Oxygen	1

It will be seen that the oxygen is in considerably less proportion than in the foregoing substances of this group, and we may consequently conclude that the hydrogen as well as the carbon is consumed in the system in maintaining the animal heat. This is an important point, as it frequently happens that the value of the heat-giving group of foods is estimated by the quantity of carbon alone. That oil has more power in maintaining animal heat than sugar or starch, is seen in the fact that it is eaten in larger quantities by men who live in cold regions than by those who live in the warmer parts of the earth. Just as we pass north or south from the tropics, man adds oil to his food according to the degree of cold to which he is exposed.

Oil seems also to be deposited in the tissues of man and other animals as a source of combustible materials when these fail in their natural food. Thus the *Ruminantia* get fat in summer to supply them with their winter's store of fuel. Hybernating animals, which are fat when they commence their sleep, wake up quite thin. Their fat has been exhausted in maintaining their animal heat during hybernation. [ADIPOSE TISSUE.]

Oil performs another function in the system. It is very evident from its general presence in every tissue of the body that it has an action in connection with the development of the proteinaceous tissues. It seems to assist their development, to act as a kind of preparation for their growth. In this way its curative action in certain forms of disease may be explained. There is no doubt of the beneficial action of cod-liver oil in scrofulous diseases, and its action can only be explained on the above supposition. In connection with the use of cod-liver oil it may be stated that animal oils appear to be in a different physical condition of aggregation from vegetable oils, and are certainly more readily digested and appropriated by the system.

The vegetable oils chiefly used as food are those obtained from the Olive (*Olea Europæa*) and the Almond (*Amygdalus dulcis*). Many seeds, as the Cocoa-Nut (*Cocos nucifera*), Almond (*Amygdalus*), Chestnut (*Castanea*), Walnut (*Juglans*), Hazel-Nut (*Corylus*), Brazil-Nut (*Bertholletia*), contain oil.

The fat of animals is the great source of oleaginous food from the animal kingdom.

We now come to speak of the Nutritious, Proteinaceous, or Nitrogenous articles of diet. The substance called Protein [PROTEIN] is the basis of these. It is the first element that appears in the development of the vegetable cell. It is consequently universally present in plants. It also constitutes the chief material of the tissues of animals. It assumes in both kingdoms various forms, and is called albumen, fibrine, and casein, according to its physical and chemical properties.

Some animals derive this constituent of their bodies directly from the vegetable kingdom, as all the herbivorous and graminivorous creatures; others derive it indirectly from the plant through the animal, as the various forms of *Carnivora*. Man obtains his supply of protein from both sources. As a sect has arisen of persons who deny the propriety of man's taking animal food, it may be well to examine the evidence on which his claim to be regarded as a flesh-eating animal rests. We shall dismiss the sentimental objection, that life ought not to be taken as unworthy of serious refutation, as every one must feel that for carnivorous animals to prey upon lower animals is a natural law.

"In the first place, the experience of the races and nations of men who partake of animal food is decidedly in its favour. Amongst the northern and European nations this practice is universal; and it is precisely amongst these people that we see the greatest amount of physical power, and moral and intellectual development existing. Amongst these nations, those individuals and classes who partake most largely or exclusively of a vegetable diet, are alike physically, intellectually, and morally degraded. It is a well-established fact, that amongst those classes who get the least animal food, as also in those public establishments where meat is only sparingly allowed, mortality is greatest, and disease is most rife. One of the most common forms of disease generated by an exclusively vegetable diet is scrofula, and when traceable to this cause, the most speedy remedy is the addition of animal food to the diet. There are also many other forms of disease produced by the want of animal food, which require for their cure but an abundant supply of the needed material. I need not, I am sure, specify facts to verify this statement. The experience of every medical man would confirm it; and there is no surgeon or physician connected with the great medical charities of this country, but has every day, unfortunately, ample opportunities of witnessing the ill-effects of a vegetable diet, and the benefit, in such cases, of the administration of animal food.

"Nor are we at a loss in accounting for the beneficial action of the flesh of animals as food. From what I have before said, it will be recollected that the muscles and other tissues of animals are composed principally of protein; so that they truly constitute the most nutritious kind of diet. It has also been found, not alone as a matter of general personal experience, but by direct experiment, that animal food is more digestible than vegetable food. The experiments to which I allude are those performed by Dr. Beaumont of America, on a man that had received a gun-shot wound in such a position as to form a perforation into his stomach. This wound never healed, and enabled Dr. Beaumont to perform the experiments alluded to. By placing various kinds of food in the stomach of this man, he was enabled to ascertain how long each required to digest; and it was found that the flesh of animals was much more digestible than any of the more nutritious forms of vegetable food, as bread, and the preparations of flour.

"Could we not find reasons for partaking of animal food in its nutritiousness and digestibility, we might find ample justification from the structure of man as compared with some of the lower animals. To the comparative anatomist it is sufficient that he knows the structure of the teeth, jaws, or stomach of an animal, to tell whether it fed on vegetable or animal food; and when he finds the structure that characterises the one or the other combined, he likewise knows that the animal will require both kinds of food. Let us, then, for one moment glance at the structure of the teeth, jaws, and stomach of vegetable-feeding animals, and compare them with creatures feeding entirely on animal food. We may take the ruminant animals, as the sheep and the ox, as specimens of pure vegetable-feeding animals. On examining their teeth it will be found that they have broad surfaces, made rough for the purpose of nibbing on each other, and between those teeth the grass and grain they eat are well ground before they are swallowed. In order that these teeth may be moved with facility over each other, the jaw, in addition to the up and down movement, which is essential to the reception of the food into the mouth, has a lateral movement, by which the trituration of the food between the teeth may be effected. The food thus prepared passes down a long œsophagus, or gullet, into a complicated bag or stomach. In the ruminants, though not in all vegetable-eating animals, a process of digestion or maceration is carried on previous to the final mastication of the food between the teeth, and its ultimate digestion in the stomach.

"If we turn now to the structure of flesh-eating animals, of which the *Carnivora*, embracing such animals as the lion and the tiger, may be taken as the type, we shall find that instead of teeth furnished with broad surfaces, they have teeth with sharp points for holding and cutting their food. Their lower jaw has no lateral movement, but a powerful up and down action, by which their sharp teeth are brought over each other and made to act in dividing their food, something in the way of the blades of a pair of scissors when used in cutting. In passing to the stomach, we find the gullet short, and the stomach small and simple in its form, adapted for food that is readily digested and speedily conveyed into the system.

"On an examination of these organs in man, it will be found that they are a true mixture of these two classes. His teeth are partly adapted for grinding, whilst some of them are supplied with the sharp projections which are characteristic of the *Carnivora*; thus evidently adapting them for the mastication of both vegetable and animal food. A slight lateral movement of the lower jaw with the up and down action is expressive of the subserviency of his structure to a mixed diet. In the stomach also we find indications of the same intermediate position in its structure; and the same conclusion is forced upon us, that it is part of the apparatus of an animal intended for subsisting upon a diet composed of animal and vegetable substances.

"That man can live on food derived entirely from plants, or entirely from animals, is a well-known fact. The natives of many parts of Asia never eat animal food, whilst the Hudson's Bay hunter, some tribes in the northern parts of the world, and the Guachos of the Pampas of America, seldom or never have vegetable food; but neither the physical, moral, nor social condition of either the one or the other would prompt the suggestion that man attains his highest development exclusively on either vegetable or animal diet. In the various positions in which man is placed in the world, there can be no doubt that the relative quantities of flesh to food derived from plants, may vary much with great advantage; but there seems to be no position in which man in health can be pronounced to be the better with abstinence from either the one or the other kind of food. That man does subsist on either exclusively only proves the great range of his adaptation to the varying conditions in which he may be placed on the surface of the earth; but certainly it is no proof of his labouring under a necessity for the supply of one to the exclusion of the other." (Lankester, 'Letters on Diet.')

Of the three forms of protein referred to above, fibrine is found in the flesh and blood of all animals, as gluten in wheat, barley, oats, rye, and the other *Cerealia*. Albumen is found in the juices of many plants, as cabbage, cauliflower, asparagus, &c.; it is also found in the nervous system and blood of animals. Casein is present in milk, also in the seeds of leguminous plants, as peas, beans, and lentils.

In the animal body is found a substance called Gelatin, which appears to be formed out of the proteinaceous tissues. [GELATIN.] This substance is necessary to the existence of the animal body, and what cellulose is in the vegetable kingdom, gelatin appears to be in the animal kingdom. Although often taken into the system with animal food, especially in soups and jellies, there appears to be no evidence that it is even converted into a proteinaceous tissue. Experiments on this subject have been performed both in France and Belgium on an extensive scale, and the conclusion arrived at was the same, that gelatin is not used for forming any of the proteinaceous tissues of the body; at the same time it is not improbable that the gelatin may be appropriated for the purpose of renewing the gelatinous portions of the tissues, which are very extensive in the animal body.

It will be thus seen that although gelatin cannot be said to be nutritious in the sense of nourishing the actively vital parts of the body, it may assist in keeping up certain parts of the fabric. It need not then be rejected from our food; but it cannot be too widely known, that, as the basis of soups and jellies, it may be administered under the supposition of its being nutritious, and thus lead, if used alone in diet, to disastrous results.

Of the forms of protein which occur in food, Casein demands a short notice. Although, as dissolved in milk, it is very digestible, it becomes, when separated and known by the name of cheese, very indigestible. When milk is deprived of its butter, and the pure casein made into cheese, as is the case with some English cheeses, as those from Suffolk, it becomes so hard as scarcely to be digestible. [CHEESE, in ARTS AND SC. DIV.] But in most cases the casein is curdled with the butter, and a large per-centage of this substance is found in all good cheeses. Stilton cheese is made by adding the cream of one milking to that of another, so that this cheese has double the quantity of butter that other cheeses possess. The indigestibility of separated or insoluble casein will perhaps explain the neglect of beans, peas, and lentils, as articles of diet, although they contain a much larger quantity of nutritious ingredients than most seeds.

In concluding these general remarks upon diet, we present our readers with a summary of the conclusions on this subject arrived at by one of our most recent physiological writers. Dr. Carpenter, in his 'Principles of General and Comparative Physiology,' thus concludes this part of his subject:—

"The waste of the tissues, of which gelatin is the basis, may be supplied either by albuminous, proteinaceous, or gelatinous compounds, since there is no doubt that albumen may be converted into gelatin, although the reverse process cannot be performed. As gelatin does not exist in plants, it must be formed in herbivorous animals at the expense of the albuminous elements of their food; whilst in carnivorous animals it is probably derived immediately from the gelatinous components of the bodies on which they prey. The materials of the adipose tissue, and the oleaginous particles which seem requisite in the formative operations of the system, generally are derived in the carnivorous races from the fatty substances which the bodies of their victims may contain; whilst the herbivorous not only find them in the oleaginous state in their food, but have the power of producing them by the conversion of farinaceous and saccharine matters.

"The foregoing statements are applicable to all tribes of animals 'cold-blooded' as well as 'warm-blooded.' We have now to consider the special case of the latter. In the carnivorous tribes the waste of the tissues is so great, in consequence of the restless activity which is habitual to them, that it appears to furnish a large proportion of the combustible material required for the maintenance of their proper temperature. The remainder is made up by the fat of the animals on which they feed; and it is to be observed that the amount of this is much greater in the bodies of animals inhabiting the colder regions of the globe than in the inhabitants of tropical countries. In the herbivorous tribes the case is different: they are for the most part much less active; and the waste of their tissues consequently takes place in a less rapid manner, and is far from supplying an adequate amount of combustible material, especially in cold climates. Their heat is in great part sustained by the combustion of the saccharine and oleaginous elements of their food, which are appropriated to this purpose without having ever formed part of the living tissues; and the demand for these will be larger in proportion to the depression of the external temperature, a greater generation of caloric being then required to keep up the heat of the body to its proper standard. Hence, cold-blooded animals can usually sustain the privation of food longer than warm-blooded, and this more especially when they are kept cool, so that they are made to live slowly, and death when at last it does ensue is consequent upon the general deficiency of nutrition. On the other hand, warm-blooded animals, whose temperature is uniformly high, must always live fast, and deprivation of food is fatal to them, not only by preventing the due renovation of their tissues, but also by destroying their power of sustaining their heat. The duration of life under these circumstances depends upon the amount of fat previously stored up in the body, and upon the retardation of its expenditure by external warmth, or by the inclosure of the body in non-conducting substances; and there is evidence that if this be duly provided for, and all unnecessary waste by nervo-muscular activity be prevented, the life even of a warm-blooded animal may sometimes be prolonged for many weeks without food."

It will be gathered from the foregoing general remarks that food may be divided into two great classes—the heat-giving and the flesh-forming; and we now present a table of some of the more ordinary kinds of food, in which one or the other, or both, of these classes of substances are found mixed:—

Table of Composition of Food in 100 parts.

Food.	Quantity of Nitrogenous Flesh-forming Ingredients.	Quantity of non-Azotised Heat-giving Principles.	Quantity of Mineral Matter.	Quantity of Carbon.
Milk	4·50	7·90	0·60	6·94
Butcher's Meat free from bone	22·30	14·30	·50	21·56
Bacon, Pork	8·36	62·50	0·50	53·92
Fish	14·00	7·00	1·00	9·15
Flour	17·00	66 00	0·70	45·50
Barley Meal	14·00	68·50	2·00	40·50
Oatmeal	13·60	70·30	3·30	44·10
Indian Meal	10·71	72·25	1·04	36·41
Peas	23·40	60·00	2·50	35·70
Rice	5·43	84·65	0·52	36·00
Potatoes	1·41	22·10	1·00	12·20
Carrots	1·48	11·61	0·81	5·40
Turnips	1·64	10·00	1·62	5·20
Parsnips	2·10	17·70	0·80	8·63
Mangel Wurzel	1·60	12·26	1·14	5·50
Cabbage	1·75	4·05	2·20	2·65
Cocoa (nibs)	9·56	85·76	2·70	68·56
Sugar	0·00	100·00	0·00	42·58
Suet, Fat, Butter	0·00	100·00	0·00	79·00
Bread	6·83	48·65	1·51	25·19
Cheese	31·02	25·30	4·90	36·80
Beer	·85	9·17	0·20	4·33
Vinegar				

100 grains of Tea give in an infusion 5 grains of theine and 26·5 grains of non-nitrogenous substances. (Peligot.)

By adding the first three columns of this table together, and deducting the sum from one hundred, it will give the quantity of water contained in each article of food. Thus, taking butcher's meat:—

Nitrogeneous material	22·3
Carbonaceous material	14·3
Mineral Matter	·5
	37·1
Water	62·9
	100·0

The quantity of carbon expresses the relative heat-giving power of the food. With foods containing fat the quantity of hydrogen should also be taken into consideration.

Such a table as this will be found useful in constructing dietaries for large institutions, which are very often erroneously constituted, and a large waste thereby entailed. The table on the next page contains examples of dietaries, drawn up by Dr. Lyon Playfair, from various sources. This table accompanied an abstract of a lecture by Dr. Lyon Playfair on the 'Food of Man,' delivered at the Royal Institution in May 1853. The following extracts from this lecture will explain some of the valuable results obtained by Dr. Playfair:—

"It was now admitted that the heat of the body was due to the combustion of the unazotised ingredients of food. Man inspires annually about 7 cwt. of oxygen, and about 1-5th of this burns some constituent and produces heat. The whole carbon in the blood would thus be burned away in about three days unless new fuel were introduced as food. The amount of food necessary depends upon the number of respirations, the rapidity of the pulsations, and the relative capacity of the lungs. Cold increases the number of respirations and heat diminishes them; and the lecturer cited well-known cases of the voracity of residents in arctic regions, although he admitted, as an anomaly, that the inhabitants of tropical climates often show a predilection for fatty or carbonaceous bodies. He then drew attention to the extraordinary records of arctic dietaries shown in the table, which, admitting that they are extreme cases even in the arctic regions, are nevetheless very surprising.

"Dr. Playfair then alluded to the second great class of food ingredients, namely, those of the same composition as flesh. Beccaria in 1742 pointed to the close resemblance between these ingredients of flesh, and asked, 'Is it not true that we are composed of the same substances which serve as our nourishment?' In fact the simplicity of this view is now generally acknowledged; and albumen, gluten, casein, &c., are now recognized as flesh-formers in the same sense that any animal aliment is.

"The old mode of estimating the value of dietaries, by merely giving the total number of ounces of solid food used daily or weekly, and quite irrespective of its composition, was shown to be quite erroneous; and an instance was given of an agricultural labourer in Gloucestershire, who in the year of the potato famine subsisted chiefly on flour, consuming 163 ounces weekly, which contained 26 ounces of flesh-formers. When potatoes cheapened he returned to a potato diet, and now eats 321 ounces weekly, although his true nutriment in flesh-formers was only about 8 or 10 ounces. He showed this further by calling attention to the six pauper dietaries formerly recommended, to the difference between the salt and fresh meat dietary of the sailor, &c., all of which, relying on absolute weight alone, had in reality no relation in equivalent nutritive value.

"Taking the soldier and sailor as illustrating healthy adult men, they consumed weekly about 35 ounces of flesh-formers, 70 to 74 ounces of carbon, the relation of the carbon in the flesh-formers to that of the heat-givers being 1 : 3. If the dietaries of the aged were contrasted with this it would be found that they consumed less flesh-formers (25—30 ounces), but rather more heat-givers (72—78 ounces); the relation of the carbon in the former to that of the latter being about 1 : 5. The young boy about 10 or 12 years of age consumed about 17 ounces weekly, or about half the flesh-formers of the adult man; the carbon being about 58 ounces weekly, and the relations of the two carbons being nearly 1 : 5½. The circumstances under which persons are placed influence these proportions considerably. In workhouses and prisons the warmth renders less necessary a large amount of food fuel to the body; while the relative amount of labour determines the greater or less amount of flesh-formers. Accordingly it is observed that the latter are increased to the prisoners exposed to hard labour. From the quantity of flesh-formers in food we may estimate approximately the rate of change in the body. Now, a man weighing 140 lbs. has about 4 lbs. of flesh in blood, 27½ lbs. in his muscular substance, &c., and about 5 lbs. of nitrogenous matter in the bones. These 37 lbs. would be received in food in about eighteen weeks; or, in other words, that period might represent the time required for the change of the tissues, if all changed with equal rapidity, which is however not at all probable.

"All the carbon taken as food is not burned in the body, part of it being excreted with the waste matter. Supposing the respirations to be 18 per minute a man expires about 8·59 ounces of carbon daily, the remainder of the carbon appearing in the excreted matter."

Examples of Dietaries.

	Weight in ozs. per week.	Nitrogenous Ingredients.	Substances free from Nitrog.	Mineral Matter.	Carbon.	Proportion between Carbon in Flesh-formers.	Proportion between Carbon in Heat-givers.	REMARKS.
DIETARIES OF SOLDIERS AND SAILORS.								
English Soldier	378	36·15	127·18	4·92	71·88	1	3·60	Public Dietaries.
English Soldier in India	261	34·15	103·19	2·39	66·32	1	3·58	
English Sailor (Fresh Meat)	302	34·82	102·80	3·17	70·55	1	3·70	
English Sailor (Salt Meat)	290	40·83	132·20	6·03	87·40	1	3·94	
Dutch Soldier, in War	198	35·21	102·08	1·85	74·08	1	3·87	Mulder.
Dutch Soldier, in Peace	383	24·52	106·80	4·15	70·77	1	5·32	
French Soldier	347	33·24	127·76	4·62	85·25	1	4·72	Special Return obtained.
Bavarian Soldier	242	21·08	102·10	3·32	62·45	1	5·47	
Hessian Soldier	423	23·00	136·00	—	77·00	1	6·10	Liebig.
DIETARIES OF THE YOUNG.								
Christ's Hospital, Hertford	216	17·16	61·27	2·47	39·18	1	4·21	Special Returns obtained.
Christ's Hospital, London	242	17·27	76·82	2·84	46·95	1	5·02	
Chelsea Hospital, Boys' School	245	12·89	93·28	5·93	57·67	1	8·29	
Greenwich Hospital, Boys' School	231	18·43	86·73	2·62	52·87	1	5·29	
DIETARIES OF THE AGED.								
Greenwich Pensioners	269	24.46	122·21	3·54	72·43	1	5·46	Special Returns obtained.
Chelsea Pensioners	332	20.05	112·64	4·65	78·03	1	4·80	
Gillespie Hospital, Edinburgh	156	21.02	02·32	2·35	71·39	1	6·26	
Trinity Hospital, Edinburgh	192	19.63	07·34	3·33	57·30	1	5·38	
OLD PAUPER DIETARIES.								
Class 1	—	20·21	88·61	3·27	54·30	1	4 05	The 6 dietaries recommended as equivalent by the Poor-Law Commissioners.
Class 2	—	14·98	89·59	2·89	51·10	1	6·31	
Class 3	—	15·78	99·88	3·91	55·43	1	6·50	
Class 4	—	19·22	116·84	3·96	67·87	1	6·50	
Class 5	—	15·40	06·51	3·58	54·72	1	6·53	
Class 6	—	14·67	83·03	2·84	40·57	1	6·25	
Average of all English Counties in 1851	—	22·00	09·00	—	58·00	1	4·85	Specially reduced from all the Unions in 1851.
St. Cuthbert's, Edinburgh	175	14·80	89·37	3·31	46·98	1	5·85	Special returns.
City Workhouse, Edinburgh	107	13·30	49·90	1·74	31·48	1	4·36	
ENGLISH PRISON DIETARIES.								
Class 2. Males	206½	15·28	111·85	3·46	50·23	1	7·13	Convicted Prisoners exceeding 7 days, but not exceeding 21 days.
Class 3. Males	276	18·26	123·60	4·05	07·53	1	6·81	Convicted Prisoners, Hard Labour, exceeding 21 days, but not more than 6 weeks.
Class 4, 8, and 7. Males	271½	20·97	125·08	5·03	69·88	1	6·13	Convicted Prisoners, Hard Labour, above 6 weeks, and not more than 4 months.
Class 5. Males	326	20·20	130·57	4·23	73·31	1	6·05	Convicted Prisoners, Hard Labour, for terms exceeding 4 months.
BENGAL PRISON DIETARIES.								
Non-Labouring Convicts	224	18·43	163·10	2·08	76·35	1	7·62	From information supplied from the India House.
Working Convicts	298	28·18	191·12	2·97	01·07	1	5·06	
Contractors' insufficient Diet	167½	12·70	135·95	1·30	61·33	1	8·88	
BOMBAY PRISON DIETARIES.								
All Classes of Prisoners not on Hard Labour	182	28·00	101·50	2·03	68·81	1	4·52	
Prisoners on Hard Labour	224	35·03	128·80	2·45	87·22	1	4·50	
ARCTIC AND OTHER DIETARIES.								
Esquimaux	—	250·00	1280·00	—	1125·00	—	—	These probably represent extreme cases mentioned by the following authorities:— Ross, 1835, p. 448. Parry, 1823, p. 413. Cochrane, p. 255. Saritcheff. Barrow, pp. 152, 258. Richardson. See 'Agric. Cyc.,' article 'Diet.'
Yacut	—	000·00	640·00	—	068·00	—	—	
Bosjesman	—	574·00	388·00	—	555·00	—	—	
Hottentot	—	424·00	400·00	—	604·00	—	—	
Agricultural Labourer, England	183·6	28·64	106·57	1·10	74·70	—	—	Gloucestershire — See 'Agric. Cyclopædia.'
Agricultural Labourer, England	114·6	20·30	72·40	1·18	51·72	—	—	Dorsetshire — See 'Agric. Cyclopædia.'
Agricultural Labourer, India	218·0	14·02	138·27	2·41	61·54	—	—	Dharwar, Bombay—Return in Bombay Prison Dietaries.

The substances used as food which we have called medicinal are very numerous. They include acids, volatile oils, and the vegetable alkaloids.

The acids are eaten in fruits, such as the citric, malic, tartaric, and oxalic acids. It is possible they may be decomposed in the system, and furnish the materials of animal heat. They seem however to perform a more important part in dissolving up the mineral ingredients taken into the system as food. This seems one way in which carbonic acid acts beneficially when taken in wines, beers, and effervescing waters. Acetic acid, or vinegar, acts probably in the same manner as the other acids.

The volatile oils are added to other kinds of food, and, as condiments and spices, form a conspicuous feature in diet. We may class these, with alcohol, as stimulants of the mucous membrane of the stomach.

The use of tea, coffee, chocolate, and Paraguay tea [THEA; COFFEE; ILEX; THEOBROMA] in infusion constitutes a curious class of alimentary substances. In tea, coffee, and Paraguay tea, a principle is found identical in every instauce, to which the name Thein or Caffein has been given. A substance very similar, Theobromine, is found in chocolate. It is undoubtedly upon the action of these substances that the dietetical uses of these plants depend.

Two theories have been advanced to explain the action of this principle. Liebig suggested that the taurin found in the bile was formed from the waste tissues of the body carried into the blood; and that this taurin was necessary for the production of carbonic acid gas, or rather to get rid of the carbonaceous matter in the system in the form of carbonic acid gas. The taurin must be constantly formed, otherwise the heat of the body is not maintained, the carbonaceous matter not got rid of, and disease is engendered. If persons have not sufficient food, or if the digestive organs do not enable them to carry a sufficient quantity of nutriment to the system, the tissues of the body are consumed to form taurin. Liebig found that thein had a composition identical with taurin, or so nearly as to render it a sufficient substitute for taurin, and thus by the use of thein he supposed we were actually preventing the waste of the body, and so maintaining health at less expense than we could by taking more solid food.

Persons who cannot consume a sufficient quantity of food to yield the carbon necessary for generating animal heat, have recourse to tea, and find it actually a nutritious article of diet; and it is only, says Liebig, "by such means as this that it can act as a nutritious agent." But another theory has beeu advanced by Dr. Playfair. He says thein has a composition very similar to nervous matter. Now, seeing that every operation of the miud must be attended with a loss of nervous matter, there is a necessity for a supply of that nervous matter to enable the mind to carry on its operations. A large quantity of proteinaceous matter would be required to be supplied to form the nervous matter with proper constituents if taken iu by means of meat or bread. But these alkaloids at once become a constituent of nervous matter; and this accounts for the agreeable stimulus and permanent effect on the mind produced by the use of tea and coffee, particularly by studious persons, as well as those whose nervous systems are exhausted from various causes.

In any just estimate of diet the mineral ingredients should be considered. The forms which they assume in the system are not well-known, but we have a capital instance in the phosphate of lime, which, forming a part of the bones, we know must be supplied through the diet. This substance is fouud in the cereal grasses, and perhaps one reason that man takes these grasses every where for the substantive articles of his diet is the possession of this substauce. Iron is another substance which is frequently deficient in the blood. It is naturally supplied in the food; but this failing, iron is given medicinally. Potash in combination with vegetable acids seems to have the power of preventing scurvy. [SCURVY, in ARTS AND SC. DIV.] Chloride of sodium is another well-known iustance of the necessity of mineral ingredients in the food.

A few plain rules for taking food will properly conclude this article.

In the first place, food should be properly cooked. Many substances which are very iudigestible when in the raw state are rendered perfectly digestible by cooking. Although the stomach is capable of digesting fruits and some kinds of seeds without any exposure to heat, yet, as a general rule, the breaking down of the tissues which occurs in cooking greatly facilitates the digestion of both animal and vegetable food. But whilst that cooking is proper which enables the stomach more easily to reduce the food to the condition of chyle, there are extremes of preparation which however palatable are to be avoided. Food that is much prepared, so as to reduce it to a fluid condition, as soups, stews, and various made dishes, do not present sufficient solid matter for the healthy process of digestion to be carried on. When the object is to prevent the stomach from doing duty such food is proper. It may also be taken occasionally with advantage as a variety in diet, but food taken long together in this form is injurious.

Much indigestible food at a time should be avoided. Many of the articles of our diet are less digestible than others, and when taken in small quantities are not injurious. It is when such substauces are made the principal constituents of a meal that danger is likely to arise. To mention only a few of the less digestible kiuds of foods :—Unfermented bread and biscuits, uncooked vegetables eaten as salad, unripe fruits, cheese, pie-crust, fat meats smoked, as bacon, and the fat of meat, some kinds of fishes, especially the *Crustacea*, crabs, lobsters, &c. Heavy meals of any one of these articles of diet, or mixtures of them, may be very injurious, and produce serious attacks of indigestion, if not other diseases.

Solid food should be well masticated before it is swallowed. The teeth are organs given us on purpose to perform this function, and its accomplishment is atteuded also with the mixture of the saliva with the food, which seems to be au important step in the process of digestion. Although by hasty mastication persons in business hope to save their time, they should know that at least it is a loss of food, if not immediately a loss of health. Much more food is digested when it is well masticated than when it is swallowed very hastily in large masses. Food that is imperfectly masticated is digested with difficulty, and remaius sometimes so long iu the stomach as to produce irritation of the stomach, and remaining uuacted upou it putrifies, producing pain and tainting the breath.

Eveu where mastication is very complete it is always better to swallow slowly, as by this means every part of the food is brought more fully under the influence of the gastric acid of the stomach, by which it is prepared for absorption into the blood.

Full and heavy meals should be avoided. It is better to get up from table with an appetite than to feel that no more food could be taken. It is always difficult to say how much should be with propriety taken. Some systems will bear twice as much food as others, whilst there are those who require twice as much food as others. Scales and weights are dangerous instruments at table, as some men will starve on what others will thrive. There is an iustinct which, if obeyed, constantly cries "Hold, enough;" which if men would listen to would always guide them right. The feelings after eating should be those of refreshment and comfort—feelings that are not ofteu present when too large a meal has been eaten. All food taken into the system and not wanted is likely to be in the way, and the processes adopted by nature for getting rid of the incubus are not unfrequently attended by disease aud death.

Persons who habitually over-eat are frequently obliged to have recourse to medicines to correct the errors of their indulgence. Such an unnatural way of correcting the evils of an unnatural habit is itself likely to produce disease in the system.

Active bodily exertion should not be taken immediately after the principal meal. The stomach requires a supply of blood to perform its functions. If the current is diverted to other organs digestion is prevented. On this account readiug at meals is an objectionable practice. The brain in this process gets the blood which the stomach requires. Long walks and hard study should both be avoided after a full meal.

Long fastiug is bad. It is bad when the body is resting; it is much worse when the body is actively engaged. The stomach, like all other organs, performs its functions iu virtue of the stimulus afforded it by the blood. If the blood is allowed to go a long time without a renewal of its constituents it no louger supplies the nervous system with energy; the stomach, and eveu other organs, flag in the performance of their duty, and as a consequence digestion is imperfectly performed. How often should man eat iu the day? In the morning, at noon, and at night, is the answer given by the instincts of man.

The body can go longer without food whilst resting than when awake; hence persons may with safety go a louger number of hours between the night and morning meal than betwecu the morniug and noon, or the noon and night meals.

There are no rules without exceptions in certaiu cases, and there are many circumstances which must modify the applicatiou of the foregoiug rules, as well as in other ways regulate the taking of food.

Age is a perpetually-modifying influeuce. The uew-born iufant requires the food which nature has provided for its use every hour or two. As it grows older the intervals at which it takes its food become longer; but it should be always recollected, that as a rule children should have more eating times thau adults. Grown-up people are too apt to assume that what is good for themselves is good for children; hence as great an amount of suffering is entailed on children by restricting the quantity and times of taking their diet amongst the rich as come upon them from absolute want amongst the poor. The craving appetite of children is no vice of fallen human nature, but the incessant demands of au ever-wasting yet ever-growing human body. Bread and butter, or treacle, or common cake, should always be allowed if asked for by rapidly growing boys aud girls between the hours which adults find conveuient for their meals. An evil however arising out of the healthy appetite of youth should be guarded against; it is, that whilst growiug a habit is acquired of eating large quantities of food which are no longer required when growth has ceased. If the appetite is not checked by reason at this period of life, the habit of eating more than is necessary may be productive of evil results.

Old age requires a more frequeut recourse to food thau the adult, though not in so large a quantity. "A little aud ofteu" is a maxim that enables many aged persous to continue their influence in the world, whilst an attempt to maintain the habits of youth and middle age has cost many declining ones their lives.

The mode of life influences the diet. The sedentary, the inactive, do not consume so much muscle and nerve in their existence as the active and laborious, and accordingly require less food. The tailor ought not to eat so much as the day-labourer; and the lady all day in her drawing-room or carriage cannot expect the appetite or the enjoyment of food which is bestowed by the laws of nature on her housemaid.

Other things being the same, more food is required in winter than in summer, more in cold climates than in hot ones. This arises from the greater consumption of certain parts of the food in maintaining the animal heat in order to keep off the external cold. Hence, to bring the appetite of Christmas to the Midsummer meal is to run the hazard of a surfeit; whilst the traveller who carries the eating habits of the north to countries under the line frequently perishes of fevers brought on by repletion.

(Moleschott, *Physiologie des Nahrungs Mittel*; Ward, *Science of Health*; *Food of Man*, in Knight's Shilling Volumes; *Lectures on the Food of Man*, by Dr. Lankester; *Letters on Diet*, by Dr. Lankester; Pereira, *On the Diet of Man*; Liebig, *Chemistry of Food*; Liebig, *Letters on Chemistry*; Archer, *Popular Economic Botany*; Carpenter, *Principles of Physiology*.)

FOOL'S-PARSLEY. [ÆTHUSA.]

FOOT. [SKELETON.]

FOOT-PRINTS, impressions of the feet of Reptiles, as of *Cheirotherium* [AMPHIBIA], and Birds (*Ornithichnites*), are now become recognised evidence of the existence of particular races of organic beings, in certain geological periods, though no other traces of them remain. By this evidence, the air-breathing *Vertebrata* appear to be of higher antiquity than was formerly supposed, and to date from the lower parts of the Silurian system.

FORAMINIFERA (*Foramen*, *fero*), a group of minute Marine Animals of low organisation, consisting of a slimy transparent jelly, invested with a hard, usually calcareous shell; found in sea-sand and amongst marine refuse dredged up from deep water. Owing to many of their shells having a spiral form, these creatures were long thought to be highly organised *Mollusca*, allied to the living *Nautilus* —an error into which most naturalists fell until recently, when these animals became the subject of a more rigorous and searching investigation than they had previously undergone.

Though usually very minute, their elegant forms early attracted the attention of naturalists. They were noticed by Gualtieri, Planchus, and Ledermuller, prior to the appearance of the 'Systema Naturæ' of Linnæus. In the latter work they are included amongst the *Nautili*, the animal, as well as that of the recent *Nautilus pompilius* with which Linnæus associates them, being alike unknown to the Swedish naturalist. In the 12th edition are descriptions of 15 species. In 1780 Soldani, an Italian priest, published two elaborate works, abundantly illustrated, and largely devoted to the recent and fossil forms of Foraminiferous Shells. He divides them into groups (such as *Nautili*, *Hammoniæ*, and *Orthocerata*) in the most arbitrary manner; but the works are monuments of his labour and perseverance. In 1784 some of the British species were figured by Walker in his 'Testacea Minuta Rariora.' The 'British Conchology' of Montague, 1803 (and 'Supplement,' 1808), contained a still larger number of British forms, respecting the majority of which the error of Linnæus was still followed; but some were shown to be so different from the true *Nautili* as to require removing from that genus. In 1803 Fichtel and Moll figured many of the spiral forms, which they included amongst the *Nautili*. In 1808 De Montfort attempted to subdivide the group into a number of separate genera, but still regarded them as *Cephalopoda*, in which view he was followed by Fleming and other more recent writers.

In 1826 the study of the *Foraminifera* received a fresh impulse from the labours of M. D'Orbigny, a French naturalist, who in that year presented his first memoir on the subject to the French Academy. This memoir embraced the classification of the whole of the Cephalopodous *Mollusca*, or animals allied to the Cuttle-Fish; with which group of organisms D'Orbigny, like his predecessors in the study, imagined the *Foraminifera* to have the closest affinities. He divided the latter into five great families, which were again subdivided into a number of genera, most of them new; the various forms being thus thrown into natural groups in a way that had not previously been attempted even by De Montfort. Though D'Orbigny retained the erroneous idea of his predecessors as to the zoological relation of the *Foraminifera*, this error did not affect the value of his subdivisions of the class, which constituted an important step in advance of all that had been done by others. Indeed the value of his classification is shown by its retention in the writings of all who have succeeded him in the study. He distributed the species into 55 genera, introducing into the catalogue an enormous number of new forms, which he discovered in sands brought to him from various parts of the globe. The views of D'Orbigny and his predecessors respecting the Molluscous character of these animals were sanctioned by Cuvier in an edition of the 'Animal Kingdom,' published in 1828.

In 1835 M. Dujardin presented a memoir to the 'Annales des Sciences Naturelles,' based upon an examination of the recent animals of the *Foraminifera*, in which he rejected the idea that they had any affinities with the *Mollusca*. He pointed out the fact that the animal which tenanted the calcareous shell was a mere animated slime, having no visible organisation, and consequently very different from the highly organised *Cephalopoda*, with which they had previously been associated. He considered their true zoological position to be near the *Amœba*, commonly known as the Proteus Animalcule, and that they constitute part of a larger group, to which he assigned the name of *Rhizopoda*. In 1834 and 1839 Professor Ehrenberg presented two memoirs to the Academy of Berlin, in which he advocated the opinion that the *Foraminifera* were polype-bearing animals, allied to the *Flustræ* and other Moss-Corals, by him termed *Bryozoa*, and of which they formed the first order, *Polythalamia*. He also assigned to them internal organs which no other observers have been able to discover: but notwithstanding these errors he did good service by the discovery that the White-Chalk Rocks were principally composed of the aggregated shells of *Foraminifera*, which by their gradual accumulation had thus produced widely-extended masses of calcareous strata, many hundreds of feet in thickness. The existence of numerous Fossil *Foraminifera* in the Chalk had been demonstrated by Mr. Lonsdale in 1835; and still later, the rich harvest of beautiful forms to be obtained from these Cretaceous strata was further demonstrated by M. D'Orbigny in his monograph 'On the Foraminifera of the White Chalk.'

In 1845 Professor Williamson published a memoir in the 'Transactions of the Literary and Philosophical Society of Manchester,' in which he further demonstrated the entire absence of any real resemblance between the *Foraminifera* and the *Cephalopoda*, and the consequent necessity of arranging the former in an inferior portion of the zoological scale. At first he adopted the idea of Ehrenberg, but in a subsequent memoir (1848) he came to the conclusion that they were not polypiferous, but that they approximated to the Sponges on the one hand, and, as had been asserted by M. Dujardin, to the *Amœba* on the other: their true position in any linear arrangement being immediately above the former of these classes of objects. In another memoir, read in 1851, describing the complicated structure of some forms of the genus *Orbiculina*, Professor Williamson says, "Looking at the structure of the shell of the *Orbiculina adunca*, and especially at the large orifices which communicate between its various cavities, we cannot fail to observe that it is a reticulated calcareous skeleton, whose proportionate relation to the size of the soft animal has differed but little from that of the siliceo-keratose network of many sponges to the slimy substance with which they are invested. The attempt to isolate the various portions of *O. adunca*, and raise each portion to the rank of an individual animal, even in the limited sense in which we should admit such a distinction in the polypes of a *Sertularia* or of a *Gorgonia*, appears to me wholly inadmissible. If the soft structures of *Orbiculina* are as devoid of visible organisation as those of our British *Foraminifera*, and I have very little doubt that such will prove to be the case, the whole animal will be very little raised above the *Polypifera*, only possessing a symmetrical calcareous skeleton, which is at once both external and internal." ('Transactions of the Microscopical Society of London.')

In 1846 M. D'Orbigny published his work 'On the Fossil Foraminifera of the Tertiary Basin of Vienna,' in which he abandoned the views advocated in his earlier writings. He now recognised the inferiority of these objects to the Cephalopods, with which he had previously arranged them. He rejected the idea that they were aggregated creatures, as held by Ehrenberg, as also the existence of the intestinal canal and organs of reproduction described by the illustrious Prussian; but he arrived at the conclusion that they held a position intermediate between the *Polypifera* and the *Echinodermata*.

M. D'Orbigny says, "After what has preceded upon the characteristics of the *Foraminifera*, the comparison demonstrates that they cannot be arranged in any of the known Zoological Classes. Much less complex than the *Echinodermata* or the *Polypifera* as to their internal organisation, they have through their filaments (pseudopodia) part of the mode of locomotion of the former, and are by their isolated, non-aggregated, free existence, more advanced in the scale than the latter. This individual existence of the *Foraminifera*, the liberty which they enjoy, and their mode of locomotion, are characters which deserve to be taken into consideration. Although less complex than many *Polypifera*, they have not a common aggregate life. A multitude does not unite to form a regular body as amongst the *Polypifera*. They are locomotive, which the others are not. Their means of locomotion are complex, and the great regularity of the testaceous envelope of their segments places them far above the *Polypifera*. On the other hand, much less perfect than the *Echinodermata*, they are very inferior to them in all respects. We believe also that, because of the radiation of their filaments, the position of the *Foraminifera* is in the interval (embranchement) of the radiating animals of Cuvier, between the *Echinodermata* and the *Polypifera*, as an altogether independent class." ('Sur les Foraminifères Fossiles du Bassin Tertiaire de Vienne,' p. 19.)

There can be no doubt of their great inferiority to the *Echinodermata*, which possess a distinct alimentary canal, a nervous circulating and sexual system; and connecting with the defined digestive cavity of the polype recent discoveries respecting its reproduction by ova, through the agency of medusiform buds, we must conclude that these latter are equally removed from the structureless animals of the *Foraminifera*. In the preceding argument M. D'Orbigny forgets that the freedom, isolation, and independence, upon which he lays so much stress, are the characteristics of the fixed compound *Polypifera*, in their embryonic or larval states. Consequently this feature, which in the *Foraminifera* is normal and persistent, betokens inferiority rather than superiority to the *Polypifera*, in which aggregation and fixation indicate maturity and a higher development. The argument drawn from their symmetry is of no value. Nothing can be more symmetrical than many of the sponge spicula; and in the vegetable kingdom the symmetrical plants (*Desmideæ*) are amongst the lowest forms.

An additional memoir by Professor Williamson, in 1851 ('Quarterly Journal of Microscopical Science,' vol. i.), afforded other and still more striking evidence of the probable correctness of the views previously enunciated, as furnished by the structure of a species of *Faujasina*, and especially showed that the new growths which added to the thickness of the shell were all applied to its exterior and not to its interior, apparently indicating that the gelatinous animal had the power of extending itself over the exterior of the shell, or of retreating to its interior at will, reminding us of the movements of the gelatinous envelope in some of the less highly organised Fungiform Corals. (Rymer Jones, 'Animal Kingdom,' p. 19.) In 1845 Dr. Carpenter laid before the Geological Society of London an elaborate memoir on the structure of some interesting fossil forms belonging to the genera *Orbitoides* and *Nummulina*, which, with the publication of M. D'Orbigny on the *Foraminifera* of Cuba, constitute the chief additional works that have appeared on this subject.

The following is the latest classification of the *Foraminifera* adopted by M. D'Orbigny, and though marked by some serious imperfections, it is the best that has been hitherto published. The five principal divisions are chiefly based on the variations in the arrangement of the successively added segments.

Order 1. *Monostega.*—Animal consisting of a single segment. Shell composed of a single chamber. Genera: *Gromia*, Dujardin; *Orbulina*, D'Orbigny; *Oolina*, D'Orbigny.

Order 2. *Stichostega.*—Animal consisting of segments arranged in a single line. Shell composed of chambers superimposed linearly on a single straight or curved axis. No spiral growths:—

Glandulina, D'Orbigny.	*Rimulina*, D'Orb.
Nodosaria, Lamarck.	*Vaginulina*, D'Orb.
Orthocerina, D'Orb.	*Marginulina*, D'Orb.
Dentalina, D'Orb.	*Conulina*, D'Orb.
Frondiculana, Defrance.	*Pavonina*, D'Orb.
Lingulina, D'Orb.	*Webbina*, D'Orb.

Order. 3. *Helicostega.*—Animal consisting of segments arranged in a spiral. Chambers piled up or superimposed on one axis, forming a spiral volute:—

Cristellaria, D'Orb.	*Alveolina*, D'Orb.
Flabellina, D'Orb.	*Rotalina*, Lamarck.
Robulina, D'Orb.	*Globigerina*, D'Orb.
Fusulina, Fischer.	*Planorbulina*, D'Orb.
Nonionina, D'Orb.	*Truncatulina*, D'Orb.
Nummulina, D'Orb.	*Anomalina*, D'Orb.
Assilina, D'Orb.	*Rosalina*, D'Orb.
Siderolina, Lamarck.	*Valvulina*, D'Orb.
Hanerina, D'Orb.	*Verneuilina*, D'Orb.
Operculina, D'Orb.	*Bulimina*, D'Orb.
Vertebralina, D'Orb.	*Uvigerina*, D'Orb.
Polystomella, Lamarck.	*Pyrulina*, D'Orb.
Peneroplis, Lamarck.	*Faujasina*, D'Orb.
Dendritina, D'Orb.	*Cauderina*, D'Orb.
Spirolina, Lamarck.	*Chrysalidina*, D'Orb.
Cyclolina, D'Orb.	*Clavulina*, D'Orb.
Lituola, Lamarck.	*Gaudryna*, D'Orb.
Orbiculina, Lamarck.	

Order 4. *Entomostega.*—Animal composed of alternating segments forming a spiral. Chambers piled up or superimposed upon two alternating axes, forming a spiral:—

Robertina, D'Orb.	*Heterostegina*, D'Orb.
Asterigerina, D'Orb.	*Cassidulina*, D'Orb.
Amphistegina, D'Orb.	

Order 5. *Enallostega.*—Animal composed of alternately arranged segments without forming a spiral. Chambers disposed alternately along two or three distinct axes, not forming a spiral:—

Dimorphina, D'Orb.	*Textilaria*, Defrance.
Guttulina, D'Orb.	*Vulvulina*, D'Orb.
Polymorphina, D'Orb.	*Bolivina*, D'Orb.
Virgulina D'Orb.	*Sagrina*, D'Orb.
Bigenerina, D'Orb.	*Cuneolina*, D'Orb.
Gemmulina, D'Orb.	

Order 6. *Agathistega.*—Animal composed of segments wound round an axis. Chambers wound round a common axis, each one investing half the entire circumference:—

Uniloculina, D'Orb.	*Cruciloculina*, D'Orb.
Biloculina, D'Orb.	*Articulina*, D'Orb.
Fabularia, D'Orb.	*Sphæroidina*, D'Orb.
Spiroloculina, D'Orb.	*Quinqueloculina*, D'Orb.
Triloculina, D'Orb.	*Adelosina*, D'Orb.

The simplest type of the *Foraminifera* (*Monostega*) presents but a single segment, and is illustrated by the *Orbulina universa* (*fig.* 1), which is a small spherical shell with a lateral aperture, the interior of which has been occupied by the living jelly to which the shell owes its existence. The beautifully symmetrical *Lagenæ*, or Flask Animals (*fig.* 2), the British species of which have been figured by Professor Williamson in the 'Annals of Nat. Hist.,' also belong to this type.

In the order *Stichostega*, as for example the *Nodosaria*, *Dentalina* (*fig.* 3), the shell advances beyond the simple type of the *Monostega* by a process of linear budding. The first cell is usually spherical, as in *Orbulina*, but through the orifice in this primary cell there protrudes as a growth from the contained animal segment, a second segment, usually a little larger than the first, which speedily incases itself in a shelly covering. This new growth is successively followed by others developed in the same way, until the organism attains to its maturity, when it exhibits a series of cells arranged end to end in a straight or but slightly curved line.

In the *Helicostega*, a large and conspicuous group, the gemmation takes place with a spiral bias, producing the nautiloid form of shell which misled the earlier microscopists. Sometimes all the convolutions are visible. (*Operculina*, *fig.* 4.) In others the outer convolution embraces those previously formed, and conceals them (*Cristellaria*, *fig.* 5). In a third type all the spiral convolutions are visible on one truncated half of the shell, whilst they are embracing on the others (*Faujasina*, *fig.* 6), thus combining the other two types. Some genera, like the Stichostegous and Heliostegous orders, develop on the plan of the latter, up to a certain stage of their growth, when the arrangement of the cells ceases to be spiral and becomes straight, (*Spirolina*, *fig.* 7), as in the *Nodosariæ*. The orifices penetrating the septa and connecting the contiguous segments are sometimes single, and at others more numerous.

1 2 3 4

7 5 6

1. *Orbulina universa.* 2. *Lagena striata*, var. *perlucida.* 3. *Dentalina communis*; Chalk. 4. *Operculina.* 5. *Cristellaria Lyonsii*; Chalk. 6. *Faujasina.* 7. *Spirolina.*

In the *Entomostega* the shell is spiral, as in the *Helicostega*, but instead of each chamber being equilateral, it has a larger and a smaller side, the position of which is alternately reversed as the segments are multiplied. (*Cassidulina*, *fig.* 8.)

In the *Enallostega* the new segments are arranged alternately on opposite sides of a central line, so as to form two parallel, non-spiral, alternating series (*Textilaria*, *fig.* 9), the segments being connected by a single orifice.

The *Agathistega* present an entirely different aspect, as well as structure, from the rest of the *Foraminifera.* They are much less transparent than the majority of the other orders, being composed of a material resembling white porcelain, and which presents a rich amber-brown hue when viewed by transmitted light. They are usually more or less oblong, and as each new segment is equal to the entire length of the shell, it follows that the terminal orifice presents itself alternately at its opposite extremities. Sometimes the new segments are spread out in one uniform plane (*Spiroloculina*, *fig.* 10), at other times each new segment instead of being exactly opposite its neighbour, is a little on one side of it; consequently the chain of segments is wound round the primary central one, as the thread is around a ball of worsted. (*Quinqueloculina*, *Triloculina*.)

In the great majority of the species the interior of each chamber is simple and undivided, but there are some forms, especially amongst the *Helicostega*, in which the newer and more external chambers are subdivided either by transverse pillars or by complete partitions perforated by one or more apertures, through which prolongations of the gelatinous substance unite the various segments of the soft animal. (*Orbiculina*, *fig.* 11.) Ordinarily but one such chain of communications exist (animal of *Rosalina*, *fig.* 12); but in the cases just referred to, there is a great increase in the number of such orifices, so that the septa become completely cribriform. The distribution of these apertures affects the gemmation or mode of growth, since it is through them that the new segments are successively formed, the gelatinous substance being extended by a process of budding or sprouting. An increase in the number of such orifices is most common where the consecutive segments present a rapid increase in their size. In the genus *Orbiculina*, this growth is sometimes so remarkable that the new segments soon form concentric circles, embracing all those previously formed. (*Orbiculina complanata*, *fig* 11.) In such examples the connecting apertures are distributed round the entire periphery, and gemmation most probably takes place simultaneously through them all; so that the soft animal, if decalcified by an acid, would present a succession of rings, inclosing one another, and connected together by transverse radiating bars.

The memoirs of Professor Williamson have shown that the shell inclosing each new segment is at first very thin; but as additional calcareous chambers are formed, each such addition not only encases the new gemmation of the soft animal, but extends over all the exterior of the previously-formed shell. The exact way in which this is accomplished is doubtful; but it is probable that the soft animal has the power of diffusing itself over the shell, and depositing upon its surface additional layers of calcareous matter.

8. *Cassidulina*. 9. *Textilaria*. 10. *Spiroloculina*. 11. *Orbiculina complanata*. 11a. Part of two chambers of an *Orbiculina*. 12. Decalcified animal of a *Rosalina*. 13. *Rosalina globularis*, viewed as a transparent object showing the foramina. 14. Horizontal section of Fig. 6, showing the internal system of tubes. 15. Fossil *Nummulina*. 16. Vertical section of Fig. 15. 17. *Verneuilina tricarinata*; from the Chalk. 18. *Rosalina Lorneraria*; from the Chalk. 19. *Globigerina cretacea*; from the Chalk.

The foramina in the calcareous shell present various appearances. Sometimes they are large and conspicuous (*Rosalina globularis*, fig. 13); at others they are so small that their existence is only to be demonstrated by means of high magnifying powers. Through these foramina, long delicate processes of the soft animal, termed pseudopodia, are protruded. The exact use of these, whether for tactile, prehensile, and locomotive purposes, or for the imbibition of nutritive fluid, is not very clear; but they very probably fulfil in some degree each of these functions. They may be regarded as analogous to the prolongations which the Proteus Animalcule (*Amœba*) extends in various directions; only in the *Foraminifera* these organs are more delicate as well as more uniform in thickness than in the shelless creature referred to.

Professor Williamson has also demonstrated the existence in several species of a curious system of interspaces and branching tubes, which ramify amongst the calcareous layers forming the walls of the shells. (Horizontal section of *Faujasina*, fig. 14.) These are especially obvious in the genera *Faujasina*, *Operculina*, and *Amphistegina*. The tubes open at the exterior of the shell, especially at the peripheral margins, either by a few large or by numerous small apertures. These canals are probably designed to admit water to the interior segments of the animal, with which they communicate through the minute foramina. In some cases the pseudopodia are protruded through such of these canals as are situated in the umbilical region; but these appear to be exceptional instances.

The relations of the *Foraminifera* to Palæontology render them interesting objects to the geologist. Many of the more recent calcareous strata chiefly owe their origin to the accumulation, through successive ages, of these minute atoms. The White Chalk Rocks are mainly composed of them; vast ranges of Tertiary Strata present the same characteristic features; and though the older Limestones have been so altered by pressure and chemical agents that their origin is less clear, there are many indications that they have primarily resembled the rocks of more recent age—an inference that is rendered probable by the great extent to which sediments now accumulating in the bottom of the sea are charged with these little organisms, and in some cases entirely composed of them.

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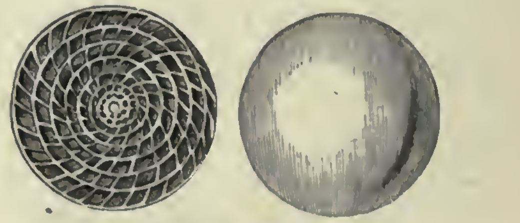

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	Rotalia (7 species British).
	Siderolina.
	Spirolina.
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Oolite of Yorkshire.	*Rotalia* (?).
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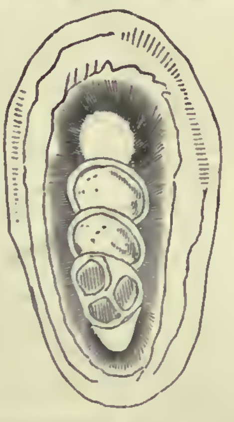
In a fossil state the shells of *Rotalia* show the minute perforations through which the pseudopodous tentacula passed, and by a careful examination of the remains of those bodies embalmed in flint Dr. Mantell ('Medals of Geology,' vol. i. p. 232) has shown the general internal arrangement of the shell, and general form, if not the minute



Foraminifer of the Mountain Limestone, forming the centre of an oolitic grain. Power 120. (Original.)

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FOREST-MARBLE, one of the upper beds of the Bath Oolite series. [OOLITE.]

FORFICU'LIDÆ, a family of Insects belonging to the order *Orthoptera*, and, according to some authors, constituting the order *Dermaptera*.

To this family belong the various species of Earwigs. They are distinguished from the Orthopterous Insects (excepting the *Blattæ* and the *Mantis* tribes, which with the *Forficulæ* constitute Latreille's family *Cursoria*) by having the posterior legs formed for running. Their wings, when folded, are almost always disposed horizontally on the body. The females have no corneous ovipositor. Both sexes however are furnished with two corneous forcep-like appendages at the hinder extremity of the body. The antennæ are slender, filiform, inserted before the eyes, and vary considerably as to the number of their joints; the thorax is generally of a rounded form, and but slightly convex.

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Earwigs appear to prefer damp situations; are found under stones and under the bark of trees, frequently in great abundance. They are also found in flowers, which they destroy by eating the leaves, &c.

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There is in this country another species of Earwig almost equally common with that we have just noticed, but which is of a much smaller size. It is found about hot-beds and dunghills, and differs from the common Earwig somewhat in its habits as well as in its structure. This belongs to the genus *Labia*.

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FORGET-ME-NOT. [MYOSOTIS.]

ments is wound round the primary central one, as the thread is around a ball of worsted. (*Quinqueloculina*, *Triloculina*.)

In the great majority of the species the interior of each chamber is simple and undivided, but there are some forms, especially amongst the *Helicostega*, in which the newer and more external chambers are subdivided either by transverse pillars or by complete partitions perforated by one or more apertures, through which prolongations of the gelatinous substance unite the various segments of the soft animal. (*Orbiculina*, *fig.* 11.) Ordinarily but one such chain of communications exist (animal of *Rosalina*, *fig.* 12); but in the cases just referred to, there is a great increase in the number of such orifices, so that the septa become completely cribriform. The distribution of these apertures affects the gemmation or mode of growth, since it is through them that the new segments are successively formed, the gelatinous substance being extended by a process of budding or sprouting. An increase in the number of such orifices is most common where the consecutive segments present a rapid increase in their size. In the genus *Orbiculina*, this growth is sometimes so remarkable that the new segments soon form concentric circles, embracing all those previously formed. (*Orbiculina complanata*, *fig* 11.) In such examples the connecting apertures are distributed round the entire periphery, and gemmation most probably takes place simultaneously through them all; so that the soft animal, if decalcified by an acid, would present a succession of rings, inclosing one another, and connected together by transverse radiating bars.

The memoirs of Professor Williamson have shown that the shell inclosing each new segment is at first very thin; but as additional calcareous chambers are formed, each such addition not only encases the new gemmation of the soft animal, but extends over all the exterior of the previously-formed shell. The exact way in which this is accomplished is doubtful; but it is probable that the soft animal has the power of diffusing itself over the shell, and depositing upon its surface additional layers of calcareous matter.

8. *Cassidulina*. 9. *Textilaria*. 10. *Spiroloculina*. 11. *Orbiculina complanata*. 11a. Part of two chambers of an *Orbiculina*. 12. Decalcified animal of a *Rosalina*. 13. *Rosalina globularis*, viewed as a transparent object showing the foramina. 14. Horizontal section of Fig. 6, showing the internal system of tubes. 15. Fossil *Nummulina*. 16. Vertical section of Fig. 15. 17. *Verneuilina tricarinata*; from the Chalk. 18. *Rosalina Lorneraria*; from the Chalk. 19. *Globigerina cretacea*; from the Chalk.

The foramina in the calcareous shell present various appearances. Sometimes they are large and conspicuous (*Rosalina globularis*, fig. 13); at others they are so small that their existence is only to be demonstrated by means of high magnifying powers. Through these foramina, long delicate processes of the soft animal, termed pseudopodia, are protruded. The exact use of these, whether for tactile, prehensile, and locomotive purposes, or for the imbibition of nutritive fluid, is not very clear; but they very probably fulfil in some degree each of these functions. They may be regarded as analogous to the prolongations which the Proteus Animalcule (*Amœba*) extends in various directions; only in the *Foraminifera* these organs are more delicate as well as more uniform in thickness than in the shelless creature referred to.

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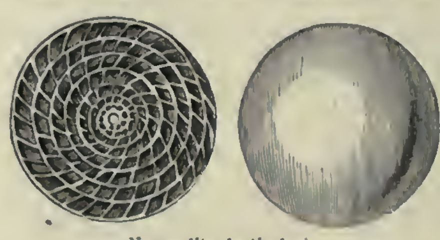

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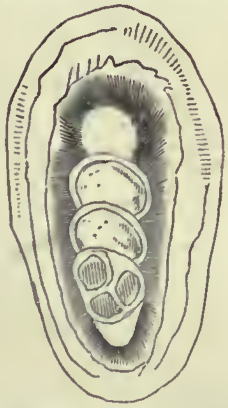

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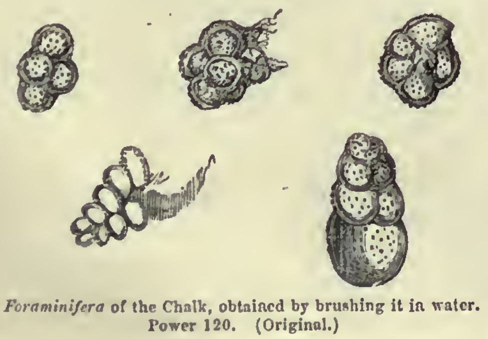

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FORGET-ME-NOT. [MYOSOTIS.]

FORMATION, a geological term subordinate to 'system,' and including special 'groups,' or assemblages of strata; in a looser sense it applies also to pyrogenous rocks and mineral veins.

FORMICA a genus of Insects belonging to the family *Formicidæ*. It is distinguished by having the foot-stalk of the abdomen composed of a single joint, the mandibles triangular, and denticulated at the edge. The females are destitute of a sting. This genus comprises about a dozen British species, the largest of which is the Hill-Ant or Horse-Ant, *F. rufa*. The neuters in this species are about one-third of an inch long, of a black colour, with the thorax, abdominal scale, and a large part of the head, red. It makes its large conical nest in the open ground in woods, &c., amassing together large quantities of sticks, straws, &c. For a description of these nests see ANT.

F. sanguinea is of a blood-red colour, with the eyes and abdomen black, and the wings dusky at the base. The neuter is similarly coloured, except that the head is darker. The male is black, with red legs. This species burrows in wood, and is one of those which steal the young of other species, rearing them to perform the duties of the nest. Two of the species subject to these marauders are *F. cunicularia* and *F. fusca*, both of which are inhabitants of this country. The latter species is of a shining black colour, with a slight ashy tinge; its form is rather long, and it is nearly smooth; the three or four basal joints of the antennæ are of a red colour, as are also the legs; the abdominal scale is large and triangular; and the ocelli are distinct. It establishes its nest under stones, moss, &c., and at the foot of trees, the nest being entirely under ground.

Among the exotic species of this genus are to be found many which are extremely injurious or annoying in their habits. Of these the Sugar-Ant of the West Indies is perhaps the most extensively prejudicial. *F. saccharivora*, as it is called, establishes its nest at the root of sugar-canes, lime-trees and lemon-trees, where it loosens the earth so that the trees are either blown down by the violent gales, or so completely deprived of nourishment at the roots that they soon die. Some years ago the injuries committed by this insect were so great that a reward of 20,000*l*. was offered by the planters to any one who should discover an effectual mode of destroying them, yet nothing could be found to stay their ravages. The aid of fire was even resorted to in vain; the insects rushing into the flames in such myriads as to extinguish it. Heavy torrents of rain at last effected their destruction.

F. indefessa, another exotic species, is described by Colonel Sykes as being an extraordinary instance of the operations of instinct in so low a form of animal life. The fondness of these insects for sweet substances is very great, and their attacks on such things were resisted in every possible manner, yet although the table, on which the confectionary and sweets were, was placed with its legs in water and removed a short distance from the wall, they succeeded in reaching them, to the great astonishment of all, until the mode of access was discovered. Colonel Sykes says, "I observed an ant upon the wall about a foot above the level of the sweets; it fell, and instead of passing between the wall and the table and alighting upon the ground it fell upon the table." Others followed its example with similar success; and it was no longer a matter for doubt as to how they continued to swarm in such numbers about their favourite food, however carefully guarded.

FORMICIDÆ, an extensive family of Hymenopterous Insects, belonging to the section *Aculeata*, and to the sub-section *Heterogyna* of Latreille, comprising the Linnæan genus *Formica*, or the numerous tribes of Ants. The family is distinguished by the wingless state of their abortive females, by the great length of the basal joint of the antennæ in the females and the neuters, in which they are elbowed at the extremity of this joint, and by the first or the first and second joints of the abdomen being knotted; the upper lip of the neuters is large, horny, and perpendicular, falling between the jaws; the eyes are rounded, or oval and entire; the jaws are large in many of the species, the form of these organs varying greatly in many of the species. In their structural character the *Formicidæ* resemble the *Tiphiæ* and *Doryli* belonging to the section of the Sand-Wasps. The neuters are smaller than the males, and these are smaller than the females; the abdomen in the first and last of these sexes is composed of six segments, in the male of seven. The females and neuters are furnished with a sting in many of the species. Those species which have stings emit an irritating fluid into the wounds which they make, while the stingless species discharge a red transparent fluid on to the skin, causing painful blisters.

The various genera of this family, according to Latreille, are:— *Formica*, *Polyergus*, *Ponera*, *Myrmica*, and *Atta*. This last genus differs from *Myrmica* only in having very short palpi; the head of the workers is generally very thick. *Acephalota* is the Visiting Ant of the West Indies. [ANT; FORMICA; POLYERGUS; PONERA; MYRMICA.]

FORSTERITE, a Crystallised Mineral, the primary form of which is a right rhombic prism. The crystals are colourless, translucent, brilliant, and small; they are harder than quartz. This substance occurs at Vesuvius accompanied by pleonaste and pyroxene. It has not been accurately analysed, but contains silica and magnesia.

FOSSIL COPAL was first found in the Blue Clay at Highgate, near London; it occurs also at Wochlow in Moravia.

It occurs in irregular pieces or small nodular masses. Its colour is yellowish or dull brown; nearly opaque. Lustre resinous. Fracture conchoidal. Specific gravity 1·046. When heated it yields an aromatic odour, and melts into a limpid fluid; it burns with a yellow flame and much smoke. When strongly heated in contact with the air, it is totally dissipated.

FOSSILS. The term 'Fossil,' in its general acceptation, signifies that which may be dug out of the earth. In this sense, antiquities, as well as natural metallic and mineral bodies, may be said to be fossils. But the word is generally used among geologists and mineralogists sometimes to designate simple and compound mineral bodies, such as earth, salts, bitumens, and metals, but more generally the petrified forms of plants and animals which occur in the strata that compose the surface of our globe. Most of these fossil species, many of the genera, and some of the families, are extinct; and all of them were considered in the darker ages to owe their origin to the plastic power of the earth. They were named *Lapides idiomorphi*, *L. figurati*, and, as their organic nature began to be suspected, *L. diluviani*. Superstition was, in old times, busy with some of them, the Belemnites and Ammonites for example.

The appellation *Petrifacta*, 'Petrifactions,' soon became common in books and catalogues of cabinets, and then Sir John Hill's proposition to denominate such petrified bodies extraneous or adventitious fossils, was adopted by many naturalists. Parkinson objected to 'Petrifactions' as a general term, and distinguished 'Fossils' by employing the expression 'Primary Fossils' to denote those mineral substances which are supposed to have been native, or, in other words, to have existed primitively in the earth; and by applying the appellation 'Secondary Fossils' to the petrified exuviæ of plants and animals. Though the terms of this last-mentioned writer are now no longer adopted, he must always be considered as one of the fathers of this branch of geology, a branch which William Smith first effectively used as the key to the stratification. In the steps of Smith the first writers on this subject have since trod; and the study of 'Organic Remains,' by which name the animal and vegetable bodies penetrated by or converted into mineral substances are now known as a whole, has become of first-rate importance in deciphering the history of the lithological structure of the earth's crust. The well-known Eocene, Miocene, and Pliocene periods of Lyell, for instance, depend in a great degree upon the proportionate absence or presence of living species among the organic remains which have hitherto been discovered in certain groups of strata of comparatively modern origin.

Some notices of the fossil plants and animals, when such are known, are given in the articles which relate to existing families, genera, or species; and extinct families, genera, and species are treated of under their respective heads.

FOSSORES, a family of the aculeated *Hymenoptera*. [HYMENOPTERA.]

FOUQUIERA'CEÆ, a natural order of Plants belonging to Lindley's syncarpous group of Polypetalous Exogens. The species are trees or shrubs, with entire oblong fleshy clustered leaves, seated in the axil of a spine or a cushion, with scarlet flowers arranged in a terminal spike or panicle. The sepals are 5, imbricated, ovate, or roundish; the petals 5, regular, combined in a long tube, arising from the bottom of the torus or calyx; the stamens 10 or 12, arising from the same line as the petals, but distinct from them, exserted; the anthers 2-celled; the ovary superior, sessile; the style filiform, trifid; the ovules numerous; the capsule 5-cornered, 3-celled, 3-valved; the valves bearing the dissepiments in the middle; the seeds in part abortive, compressed, winged, affixed to the axis; the embryo strait, in the centre of thin fleshy albumen; the cotyledons flat. This order was separated by De Candolle from *Portulaceæ* for the following reasons:—"1, because the petals were in a long tube of the same nature as that of gamopetalous *Crassulaceæ*; 2, because the capsule consists of three loculicidal cells, that is to say, which separate through the middle, forming three septiferous valves; and 3, because the embryo is straight, with flat cotyledons, and stationed in the centre of fleshy albumen." (Lindley, 'Nat. System.') In the structure of their flowers *Fouquieraceæ* resemble *Crassulaceæ*; and in the character of their fruit, *Loasaceæ*, *Turneraceæ*, and *Stackhousiaceæ*.

There are only two genera comprehended in this order: *Fouquiera*, named after Dr. Peter Edward Fouquiere, a professor of medicine at Paris; and *Bronnia*, named in honour of Henry George Broun, who has written on leguminous plants. Each of these genera has a single species: both plants are natives of Mexico. Of their properties little is known.

F. formosa is a showy shrub, and may be grown in a light rich soil, and propagated by means of cuttings, which will root freely in sand under a hand-glass in heat. *Bronnia* has been referred by some botanists to *Tamaricaceæ*.

(Lindley, *Natural System*; Burnett, *Outlines of Botany*; Don, *Dichlamydeous Plants*.)

FOX. [VULPIDÆ.]

FOXGLOVE. [DIGITALIS.]

FOX-GRAPES. [VITIS.]

FOX-TAIL-GRASS. [ALOPECURUS.]

FRACTURE, in Mineralogy, means the irregular surface which appears when a mineral is broken, so that surfaces do not constitute a Cleavage. The kinds of fracture are determined by the aspect and forms of the surface presented by the mineral. Werner divides the varieties of fracture into compact, fibrous, radiated, and foliated. The compact may be splintery, even, conchoidal, uneven, earthy, or hackly. The fibrous may be coarse or delicate, straight or curved, parallel or diverging; and the diverging again is either stellular, scopiform, or promiscuous. The radiated fracture is broad or narrow, straight or curved, diverging or promiscuous; and streaked or smooth.

FRAGILARIA. [DIATOMACEÆ.]

FRANCOA'CEÆ, *Francoads*, a very small natural order of Exogens, consisting of the genera *Francoa* and *Tetilla*. They are South American herbaceous plants, with lyrate radical leaves and a scapose inflorescence. The sepals and petals are four; the stamens four times as numerous and hypogynous, half of them being rudimentary. The pistil consists of four carpels adhering by their interior angles, with a sessile 4-lobed stigma. The seeds are numerous, and contain a minute embryo lying in a mass of fleshy albumen. Great differences of opinion have existed among botanists as to the affinities of this order. Dr. Lindley states that its nearest affinity is with *Dionæa*, which chiefly differs in its unilocular fruit, anisomerous flowers, and the want of sterile stamens. Its seeds are absolutely the same in all essential respects.

A portion of the flower-stem of *Francoa sonchifolia*.

1, the stamens and pistil; 2, a transverse section of the ovary; 3, a seed; 4, the nucleus of the seed taken from within the spongy testa; 5, a longitudinal section of the nucleus showing the minute embryo.

FRANCOLIN. [PERDICIDÆ.]

FRA'NKENIA, a genus of Plants, the type of the natural order *Frankeniaceæ*, and named in honour of John Frankenius, a professor of botany at Upsal, and the first enumerator of the Swedish plants in 'Speculum Botanicon.' It has a 5-cleft style, the lobes oblong, with the stigmas within. Capsules 1-celled, with three or four valves, and many seeded. These plants are small and heath-like, with prostrate stems; the flowers usually rise from the forks of the stem, or are disposed in terminal corymbs.

F. pulverulenta, the Powdery Sea-Heath, has its leaves opposite in whorls, obovate, retuse, glabrous, and the under surface powdery, with ciliated petioles; a slender root, and axillary terminal flowers of a pale red-colour. This plant grows in the sand by the sea-shore in many parts of Europe and Asia; it is occasionally found on the coast of Sussex in England, but is very rare.

F. lævis has clustered, linear, glabrous leaves, with revolute margins, ciliated at the base; prostrate downy stem, and terminal axillary solitary flowers. It is a native of the muddy salt-marshes by the sea-coast, in many parts of Europe and the Canary Isles. In England it is found principally on the eastern coast, and flowers in the months of July and August. The flowers are generally flesh-coloured, but sometimes white, with yellow claws.

Don enumerates 16 species of this genus, besides those already named as being found in Great Britain. Of those not British plants the majority occur in Africa and Australia, and some are found in South America. *F. hispida* grows on the rocks extending from the island of Cyprus to Siberia. The hardy species of this beautiful evergreen genus are well adapted to ornament rock-work, and may be easily cultivated. They may be propagated by cuttings or by dividing the roots, and may also be grown from seed under a hand-glass.

(Don, *Dichlamydeous Plants;* Babington, *Manual of British Botany.*)

FRANKENIA'CEÆ, *Frankeniads*, a small natural order of Exogens, allied to *Violaceæ* and *Sauvagesiaceæ*, with a procumbent habit, small leaves, and very often minute flowers half hidden among the leaves. They are all furnished with a tubular ribbed calyx, and that, together with their having 5 petals, a definite number of hypogynous stamens, and a 1-celled capsule bursting into valves, to whose edges the seeds adhere, gives them a distinctly limited character. The species are chiefly found in the south of Europe and north of Africa; they however occur in various other parts of the world; four species from Australia; two are natives of the Cape of Good Hope; one of South America; and three of temperate Asia. Endlicher says they are mucilaginous and slightly aromatic. The leaves of *Beatsonia portulacifolia* are used in St. Helena as tea. *Frankenia pauciflora*, remarkable for the size of its flowers, is a very pretty greenhouse shrub.

A twig of *Frankenia pulverulenta*, natural size.

1, a flower; 2, the pistil and stamens; 3, a transverse section of the ovary, all magnified.

FRANKINCENSE, a resinous substance, the produce of the *Abies excelsa* (De Candolle), the *Pinus abies* (Linn.), Common Spruce-Fir, from which it either exudes spontaneously or more abundantly from incisions of the bark. When it first flows out it is liquid, but on exposure to the air concretes, and is collected during autumn and winter. It occurs in two states, in tears (*Thus*, or *Olibanum sylvestre*), and in large irregular lumps or compressed cakes. When recent the colour should be white, or only inclining to yellow, subdiaphanous, soft, tenacious, and glutinous: by the action of time it becomes hard, and even friable, the colour having deepened into an orange hue. By the heat of the hand it softens, and by a higher temperature liquifies. It possesses a turpentine-like odour and taste. It is insoluble in water, but completely soluble in alcohol with the aid of heat.

It consists of two kinds of resin mixed with oil of turpentine. By melting it in water, and straining it through strong cloths, it is deprived of much of its oil, when it is termed Pix Arida, or Burgundy Pitch.

For the genuine Thus, or Frankincense of the ancients, see BOSWELLIA; also OLIBANUM, as the substances distinguished by this name (derived from the Arabic Loohan) were of different kinds, and procured probably from Africa and Arabia, as well as from India.

FRANKLINITE, a Mineral which occurs in attached crystals, granular, and massive. The primary form of the crystal is a cube; its colour is deep iron-black. Opaque. Lustre metallic. Specific gravity 4·87 to 4·09. Hardness 6·0 to 6·5. Streak deep red-brown. Cleavage parallel to the planes of the regular octahedron, but very indistinct. Fracture conchoidal. Magnetic, but without polarity.

The massive varieties are amorphous. Structure granular, compact. This mineral is found at Franklin, New Jersey, North America.

According to Berthier it consists of—

Peroxide of Iron	66
Oxide of Zinc	17
Red Oxide of Manganese	16
	— 99

FRATERCULA. [AUK.]

FRAXINELLA, the common name of a Plant belonging to the genus *Dictamnus*, which is referred to the order *Rutaceæ*. *Dictamnus* has a 5-parted, unequal, deciduous calyx; 5 unequal unguiculate petals; 10 declinate stamens with awl-shaped filiform unequal filaments, having glandular tubercles at their apex, and roundish anthers; the style single, diclinate, striated lengthwise, terminated by a blunt papillose stigma; the capsule stipitate, composed of 5 carpels, which are connected on the inside, compressed, 2-seeded.

D. Fraxinella, Bastard or False Dittany, False White Dittany, Fraxinella, has 4-5 pairs of leaflets, cordate at the base, acute at the apex, finely serrulated; the racemes long; the calyx unequal. It is found wild in the south of Europe, especially in Germany, France, Spain, Austria, and Italy.

The leaves, flowers, and stem of this plant, when gently rubbed, emit a strong lemon odour, and when bruised the scent is more powerful. The volatile oil which gives it its peculiar odour is secreted in the largest quantities in the pedicles of the flowers, which are covered with little glands of a rusty red colour, which exude a viscid resinous juice. The volatile oil from this plant is evolved in so large quantities that it will burn when a light is held near it, and, in a dark place, may be seen to take fire. It was formerly used in medicine under the name of ***Dictamnus albus***, and the root was considered stomachic, anthelmintic, and aperient. Stoerck, to whom we are indebted for the re-introduction of so many European plants into modern medicine, recommended it in epilepsy, intermittent fever, and amenorrhœa. The plant used in medicine under the name of ***Dictamnus Creticus***, the Dittany of Crete, is the ***Origanum Dictamnus*** of Linnæus. [ORIGANUM.]

D. angustifolia, has 4-5 pairs of leaflets, alternate, ovate-lanceolate, acuminated, finely serrulated; the racemes long; the calyx nearly equal. It is a native of the Altaï Mountains.

There are several varieties of *Fraxinella* found in gardens, with white, red, and purple flowers. They will grow in any common garden soil, from seeds, which ripen well in this country.

(Don, *Dichlamydeous Plants;* Burnett, *Outlines of Botany;* Lewis, *History of Materia Medica.*)

FRA'XINUS, a genus of Plants belonging to the natural order *Oleaceæ*, under which the Common Ash is comprehended. They inhabit various parts of the more temperate regions of the northern hemisphere, both in the Old and New World, but are unknown in a wild state in the southern. Although, if strictly limited, the species are destitute of corolla, yet the genus does, in fact, belong to the natural order of the olive and lilac, a transition to which is afforded by what are commonly called Flowering Ashes, the *Orni* of modern botanists, in which a corolla exists in the form of four long narrow petals. Both these genera have the kind of fruit called a key, or technically, a 'samara,' that is, a seed-vessel which does not open, which contains one or two cells, and which is prolonged into a thin wing at the apex. As they are all called ashes in the gardens, and are exceedingly nearly related to each other, we notice them both in this place.

Fraxinus, or True Ashes.

Of these the most important is the Common Ash (*F. excelsior*), a tree inhabiting the cooler parts of Europe, from Great Britain to a considerable distance through Asia. It is said to exist in Japan in a wild state, but this requires confirmation; it does not occur in North America, but species similar to it in appearance are common on that continent. The ash is one of the most useful of our British trees, on account of the excellence of its hard tough wood, and the rapidity of its growth. In its appearance too it is singularly graceful for a European tree, often resembling in its slender stems and thin airy foliage the acacias of tropical regions. Every one who has seen the beautiful effect of the ashes mingled with the ruins of Netley Abbey, near Southampton, must have been struck with this peculiarity. The principal objection to the ash is the injury it does to the plants which grow in its neighbourhood, by rapidly exhausting the soil of all its organisable materials. In consequence of this, few plants will thrive, or even grow near it; and hence the impropriety of the common practice of planting the ash in hedgerows; the extent of its roots may always be distinctly traced by the langour and paleness of the crops that stand near it. Many varieties, or supposed varieties of it, are known to cultivators, and many more might easily be collected if it were worth the while; for it sports very much in a wild state. The most striking of the reputed varieties are the following:—

1. *F. pendula*, the Weeping Ash; with all the characters of the common wild tree, except that the branches grow downwards instead of upwards, so that if grafted upon a lofty stem the head will soon reach the ground and form a natural arbour. This is said to have originated accidentally in a field at Gamlingay, in Cambridgeshire.

2. The Entire-Leaved Ash; with all its leaves simple, broad, ovate, coarsely serrated, and puckered. Nothing can well be more unlike the common ash than this, which nevertheless appears upon good authority to be merely a seedling variety. Out of leaf it is hardly distinguishable by its branches from its prototype.

3. *F. crispa*, the Curled-Leafed Ash; with very short stunted branches, and deep green crumpled leaves. If this is, as it is said to be, a mere monstrous variety of *F. excelsior*, it is one of the most remarkable with which we are acquainted. It has a particularly dark aspect; its leaves are so thick, and its shoots so short, that it forms a blackish round-headed tree of the smallest dimensions. Its origin is unknown; it, as well as the *Ornus*, is sometimes called *F. Theophrasti*.

4. *F. verrucosa*, the Warted-Barked Ash. In this the stems are covered over with a great number of little grayish brown tubercles; otherwise the plant has the appearance of the common ash.

Besides this, the only European ash that deserves notice is the *F. parvifolia*, Small-Leaved Ash. Its foliage is much finer and narrower than in *F. excelsior;* the leaflets are narrow and finely serrated, the bark is rugged, the growth slow, and instead of the toughness so characteristic of the latter species, the branches are so brittle as to be liable to constant injury from high winds. It is however a very beautiful tree, and for ornamental purposes where size is no object, it should be planted, especially as a single tree. It is possible that *F. rostrata* may be a variety of it: but nothing can be more erroneous than the idea that it is itself a variety of *F. excelsior*. It is found only in the southern parts of Europe.

In the Levant occurs the *F. lentiscifolia*, Lentisk Ash, a most graceful species, with long narrow leaves, composed of five or six pairs of small, distinct, sharply serrated, shining leaflets. It inhabits the country about Aleppo, and is hardy in this country, where it forms a tree of the most elegant appearance, intermediate, as it were, in appearance between a willow and an ash. The branches are deep rich purple. It is often called *F. Chinensis* in the nurseries.

With regard to the species of American Ash we have, in the first place, to remark that they are not well adapted to this climate, being in general too ill prepared by our short cold summers to bear our winters, and moreover injured by spring frosts: circumstances much to be regretted, because some of the species prove very handsome trees. In the second place, the number of species has no doubt been greatly exaggerated by writers upon garden botany; we cannot however at all agree with a modern writer upon these subjects, who believes all the American ashes to be one and the same species. The following are, we think, undoubtedly distinct:—

F. pubescens, the Black American or Downy Ash, with three or four pairs of leaflets, which are nearly entire, flat, downy beneath, as well as the branches. A swamp tree in the middle states of the American Union.

F. Americana, the White American Ash, with seldom more than three pairs of leaflets, which are smooth, flat, nearly entire, and glaucous on the under side; the branches smooth. A large tree in Canada and the northern states of America.

F. sambucifolia, the Water-Ash, or Elder-Leaved Ash, with three or four pairs of leaflets, which are rugose, constantly serrated, hairy at the axils of the leaves underneath; when bruised smelling a little like elder; buds deep blue. A common tree in forests in the northern parts of North America.

F. quadrangulata, with the shoots distinctly and sharply quadrangular. A tree from Ohio, among the most unsuitable of the American ashes for this climate.

F. epiptera, the Wing-Topped, Seeded, or Two-Coloured Ash, with the keys very broad and wedge-shaped at the upper end and taper at the base. The young branches are green, covered with white dots. A small tree, found all through the American Union.

All the foregoing can be procured in the English nurseries, and they perhaps form the only distinct species of the genus. A great many supposed species were distinguished by the late Mr. Bosc, whose names are current in collections; but they can scarcely be determined with precision. A fine collection of Ashes exists in one of the enclosures in Kensington Gardens.

F. Caroliniana, the Carolina Ash, has 2 or 3 pairs of leaflets, oval, petiolate, serrated, glabrous, and shining above. The flowers are calyculate. The branches glabrous and, like the buds, brownish. The racemes loose, an inch and a half long, often twin from the same bud. The pedicles numerous and umbellate. The calyx small and campanulate. It is a tree from 30 to 50 feet high; native from Pennsylvania to Carolina. It is a very remarkable variety, readily distinguished by the size of its leaflets, which are nearly round. In America it is entirely neglected as a timber-tree, and in Europe it is solely considered as ornamental.

There are a great many varieties of the species *F. excelsior*, some of which undoubtedly deserve to be considered distinct species. Several of them yield the sweet resinous laxative substance known by the name of Manna. *F. excelsior* not only produces it in the warm climate of South Europe, but is reported to have a tonic febrifugal bark and leaves almost as cathartic as those of Senna, producing unequivocal action on the system.

The species of this genus which most extensively produce Manna are now described under the genus

Ornus, or Flowering Ashes.

O. Europæa, or Common Manna-Ash, is a small round-headed tree, with leaves resembling those of the Common Ash, only the leaflets are elliptical, abruptly acuminated, and have a considerable collection of hairs at the base of the midrib underneath. In the summer when the leaves are full grown the trees become ornamented with a profusion of white delicate blossoms, which give them a strikingly beautiful appearance. The species inhabits the southern parts of Europe, especially the woods of Calabria and Apulia, and in those countries flowers in April.

O. rotundifolia is universally distinguished as a second species of this genus; differing in its leaves being much longer, the leaflets roundish, ovate, acute, not cuspidate, coarsely serrated, entire, and rather cuneate at the base, and not at all hairy underneath. In flowers it is much the same. It is a native of Calabria and elsewhere in the south of Europe.

These two plants are interesting as producing the sweet laxative substance known in the apothecaries' shops under the name of Manna. It is a secretion from the leaves and branches; and, according to Fée, is caused either by artificial wounds or by the puncture of an insect. Both species yield the substance, but, according to Tenore, that from *O. rotundifolia* is of better quality than the other.

"In Calabria and Sicily," says this physician, "in the hottest part of the summer months, the Manna oozes out of the leaves, and from the bark of the trunk and larger branches of the *Fraxinus*, or Calabrian Ash. The *Ornus* likewise affords it, but from the trunks and larger branches only, and that chiefly from artificial apertures; whereas it flows from the *Fraxinus* through every little cranny, and bursts through the large spores spontaneously. The different qualities of the Manna are from different parts of the tree."

The sweetness of this substance is not due to the presence of sugar, but to a distinct principle called Mannite, which differs from sugar in not fermenting with water and yeast. Some trees yield the Manna spontaneously; these only grow in the most favourable situations, and the sap runs out during the greatest heat of summer. It begins to ooze out about mid-day, in the form of a clear liquid, which soon thickens, and continues to appear till the cool of the evening, when it begins to harden into granules, which are scraped off the following morning. This kind is called 'Manna in Tears,' and is as pure and white as the finest sugar. Inferior qualities are obtained by making incisions in the trees, which forms the principal part of the Manna sold in our shops.

(Loudon, *Arboretum Britannicum*.)

FRAZE'RA, a genus of Plants belonging to the natural order *Gentianaceæ*, named after John Frazer, a collector of North American plants. It has a 4-cleft deeply-parted calyx. The corolla 4-parted, rotate, deciduous, with a bearded orbicular gland in the middle of each segment. The stamens 4, inclosed; filaments filiform; the capsule compressed, partly margined, 1-celled. The seeds few, imbricated, elliptical, winged, and fixed to the margins of the valves.

F. Carolinensis, the *F. Walteri* of Michaux, is the only species of this genus. It has a biennial root; stem from 3 to 5 feet high, erect, sub-quadrangular, and smooth; leaves opposite and verticillate, oblong, lanceolate, the lower ones a foot long and more than 3 inches broad; flowers in aggregate clusters. This plant is indigenous in the swamps of the Carolinas, and is found on the borders of lakes in Pennsylvania and New York. The whole plant has a very stately appearance, and in character approaches so near to *Swertia* that, without examining the fruit, it might be mistaken for a species of that genus. The root yields a powerful bitter, nearly as pure as that of quassia, and wholly destitute of aroma. It is fully equal in its medicinal effects to gentian, and when fresh is said to be emetic and cathartic. The roots have been imported into Europe as a sort of Calumba, and hence have acquired the name of American Calumba. This plant requires moisture, and flourishes best in a peat soil. It should be protected the winter after being raised from seed or that preceding its flowering.

(Don, *Dichlamydeous Plants*; Lindley, *Flora Medica*.)

FREESTONE. [SANDSTONE.]

FREGILUS. [CORVIDÆ.]

FRENCH BERRIES. [RHAMNUS.]

FRIGATE. [PELECANIDÆ.]

FRINGE-TREE, the English name of the American shrub *Chionanthus Virginica*.

FRINGILLA, a genus of Birds belonging to the order *Fringillidæ* and the division *Insessores*. The beak is straight, longer than deep, conic, and pointed; mandibles nearly equal, cutting edges entire, forming a straight commissure; nostrils basal, lateral, oval, partly hidden by the frontal plumes. Wings with the first quill-feather longer than the fifth, but a little shorter than the second or third, which are equal, and the longest in the wing. Legs with the tarsi of moderate length; toes divided, and adapted for hopping and perching; claws curved and sharp.

F. cœlebs, the Chaffinch. [CHAFFINCH.]

F. montifringilla, the Mountain Finch, Brambling, or Bramble Finch. This bird is a visiter to this country only in winter, coming to us from the north, but at different times, according to the temperature of the country from which it emigrates. They have not been known to breed in any part of this country; those kept in confinement under the most favourable circumstances have never done so. It is not an uncommon bird in Denmark. Mr. Hewitson saw them at one place in the southern part of Norway, where they were breeding. It is described as building in fir-trees; the nest formed of moss, and lined with wool and feathers; the eggs four or five in number, white, tinged with yellow, and spotted with dark red, like those of a chaffinch. The call-note of this bird is a single monotonous chirp.

FRINGI'LLIDÆ, a family of Birds belonging to the order *Insessores* and the division *Conirostres*. This family is commonly known by the name of Finches. According to Mr. Vigors this family embraces, in addition to *Alauda* [ALAUDINÆ], to which *Emberiza* (the Buntings) [EMBERIZIDÆ] and its affinities seem more nearly allied, the greater part of the Linnæan *Fringillæ*, together with the Linnæan *Tanagræ* [TANAGER], which approach them in their external characters and in their habits, as far as has hitherto been ascertained. These latter groups contain many natural genera which may be traced, in his opinion, from the point of their connection with the Linnæan *Fringillæ* back, by a gradual increase of the base of the bill in breadth and height, to the family of *Loxiadæ* [LOXIADÆ], which unites with them at the opposite extremity of the series of families which compose the tribe. The *Fringillidæ* again, according to the same author, by means of the sharp-pointed and lengthened bill of *Carduelis*, and by the extension of the culmen of the upper mandible in an angular form for some extent upon the front of the head, conduct us on the other side to the genus *Icterus* (Briss.), which commences the succeeding family. Here Mr. Vigors thinks that the genus *Ploceus* of Cuvier also seems to hold an intervening station between the two groups, so as to render it difficult to decide in which of them it should be placed. There is also, he states, another decided line of relationship between the two families, namely, that which some species of the Linnæan *Alauda*, particularly *A. Capensis*, bear to the *Sturnus Ludovicianus*, or Crescent Stare, of Dr. Latham. This latter bird is well known as the *Alauda magna* of Linnæus and of the American ornithologists. But its still stronger affinity to the *Sturni* and *Icteri* necessarily places it among them. The former relationship appears to Mr. Vigors to be one of analogy, not of affinity; while the direct passage between the families is found in *Ploceus* (the Weaver Birds). [PLOCEUS.] Mr. Vigors makes *Fringillidæ* the first, and *Loxiadæ* the last family of the *Conirostres*. Mr. Swainson makes the *Fringillidæ* (including *Loxia*, apparently; for his *Conirostres* consist of the *Corvidæ*, *Sturnidæ*, *Fringillidæ*, *Musophagidæ*, and *Buceridæ*, omitting *Loxiadæ*) the third family; and the order of the names given will show the position he assigns to it. "No group in the ornithological circle," writes Mr. Swainson in his 'Classification of Birds,' vol. i., "exhibits this powerful structure (strength of the bill) so much as that of the *Fringillidæ*, where the bill is short and nearly conic; both mandibles are equally thick, and when closed their height and breadth are nearly the same. In many of the Finches (as in the sub-genera *Amadina*, *Coccothraustes*, &c.) the thickness of the bill at its base in comparison to the size of the head is enormous; but in *Loxia ostrina* of Vieillot, a rare and most extraordinary bird from Western Africa, the bill is not much inferior to the size of the head. It is well known that all these 'hard-billed' birds, as the old writers aptly called them, feed entirely upon seeds and nuts; and the harder these are the stronger are the bills of such species as are appointed to derive nourishment from the different sorts; whenever an insectivorous and frugivorous diet is united, as is the case with most of the Tanager Finches, the upper mandible is notched for the obvious purpose of more firmly securing that part of their food which can escape."

M. Lesson, in his 'Table Méthodique,' places the *Fringillidæ* as the third family of the *Conirostres*, and makes it consist of the following genera:—*Emberiza* of Linnæus, Emberizoïdes of Temminck, *Fringilla* of Linnæus—namely, *Pyrgita*, *Fringilla*, and *Carduelis* of Cuvier; *Linaria* of Bechstein; *Vidua* of Cuvier; *Coccothraustes* of Brisson; *Pyrrhula* of Brisson; *Loxia* of Brisson; *Psittirostra* of Temminck; *Corythus* of Cuvier; *Colius* of Brisson and Linnæus; *Phytotoma* of Molina; and *Ploceus* of Cuvier.

Cuvier, in his 'Règne Animal,' arranges the Buntings (*Emberiza* of Linnæus) immediately after the Titmice (*Parus* of Linnæus); and next to the Buntings he places the Sparrows, Les Moineaux (*Fringilla* of Linnæus).

Cuvier designates the Buntings as possessing an extremely distinct character in their conical short straight bill, the narrower upper mandible of which, entering within the lower, has on the palate a hard and projecting tubercle; and as granivorous birds which have little caution, and readily enter the snares prepared for them. Those Buntings which have an elongated nail on the hind toe, like the larks, are distinguished by Meyer under the generic name of *Plectrophanes*.

The Sparrows (*Fringilla*) are characterised by Cuvier as having a conical bill more or less large at its base, but not angular at the commissure. They subsist principally on seeds, and are subdivided by that zoologist as follows:—The Weavers (*Ploceus*, Cuvier), a form found in both the old and the new continents. Those of the Old World make a nest by interweaving very skilfully the fibres of vegetables, whence their name. Such are the Toucnam Courvi of the Philippine Islands (*Loxia Philippina* of Linnæus), with its pendulous nest, having a vertical canal opening below, which communicates laterally with the cavity where the young are laid; and the Republican (*Loxia socia* of Latham), which builds in society, and whose conjoined nests form one large continuous mass with numerous compartments. Among the Weavers of the new continent Cuvier places Le Mangeur de Riz, Petit Choucas de Surinam, de la Jamaique, Cassique Noir, &c. (*Oriolus niger*, *Oriolus oryzivorus*, *Corvus Surinamensis*, Gmelin), which in countless flocks lay waste the fields of many of the warm parts of America. Next to the Weavers are placed the Sparrows, properly so called (*Pyrgita* of Cuvier), of which the well-known Common or House-Sparrow (*Fringilla domestica* of authors, *Pyrgita domestica* of Cuvier), the companion of civilised man on a large portion of the globe, may serve as the type. Cuvier makes the Finches, Les Pinçons (*Fringilla* of Cuvier), follow. These have the bill rather less arched than the sparrows, and a little longer and stronger than the linnets. Their habits are more gay and their song more varied than those of the sparrows; and the Chaffinch, Le Pinçon Ordinaire (*Fringilla cœlebs* of Linnæus), may be taken as an illustration of the genus. [CHAFFINCH.] The Linnets and Goldfinches (Les Linottes, *Linaria* of Bechstein), and Chardonnerets (*Carduelis* of Cuvier) come next, and the Serins or Tarins, Canary Birds, for example. [CANARY BIRD.] Then come the Whidah Finches, Widow-Birds, as they are popularly called (*Vidua* of Brisson and other authors); and next to them the Grosbeaks, Gros-Becs (*Coccothraustes* of Brisson and others), to which Cuvier considers there is a gradual passage from the linnets without any assignable interval, and whose completely conical bill is only distinguishable by its excessive size: of these the Common Grosbeak (*Loxia Coccothraustes* of Linnæus) may be considered as the type. *Pitylus*, to which Cuvier assigns certain foreign species, succeeds. It has, as well as *Coccothraustes*, a large bill, which is slightly compressed, arched above, and sometimes has a salient angle in the middle of the edge of the upper mandible. The Bullfinches (*Pyrrhula*) conclude the tribe.

After the Sparrows Cuvier places the Crossbills (*Loxia* of Brisson), and the Durbecs (*Corythus* of Cuvier, *Strobilophaga* of Vieillot), observing that they cannot be placed at a distance from the bullfinches and crossbills. The bill of *Corythus*, convex all round, has its point curved above the lower mandible. *Colius* he considers as nearly approaching the preceding.

M. Temminck thus defines the character of the Buntings (*Emberiza* of Linnæus):—Bill short, strong, conical, compressed, trenchant, without a notch; mandibles having their edges included (the upper mandible being smaller than the lower), and a little distant from each other at the base. Nostrils basal, rounded, surmounted by the frontal feathers which partially cover them. Feet with three anterior and one posterior toe, the anterior toes entirely divided and the posterior toe with a short and curved nail: in a small number of species this nail is straight and long. Wings with the first quill rather shorter than the second and third, which are the longest. Tail forked or slightly rounded.

It will be observed that in this generic character M. Temminck has omitted the projecting tubercle on the palate, and he gives as a reason for this omission that it is not visible externally.

The principal food of the Buntings consists of farinaceous seeds, to which insects are occasionally added. The greater number haunt woods and gardens, and build their nests in bushes. Those which have the posterior nail or claw long live among the rocks, or in the plains, and do not frequent the woods. In almost all the species the sexes present a marked difference, the males being variegated with lively and well-defined colours. The young may be distinguished from the females, which they much resemble, by their more sombre colouring, and a greater number of deep spots. None of the indigenous species moult twice, but the greater part of the foreign species do so regularly, and the colours of the males change considerably in these two moults: in the summer they are adorned with brilliant colours; in the winter they put on the modest livery of the females. (Temminck.)

The same ornithologist divides the Buntings into two sections:—

I. The Buntings properly so called.

These have the posterior claw short and curved, and live in the woods and gardens. They appear to moult but once a year. Some parts of their plumage, which are coloured with lively tints in the summer, are clouded in winter by the ashy shading with which the feathers are terminated; these colours are without mixture in the spring, especially the deep black, till it becomes clouded with reddish after the autumnal moult. The common Yellow Hammer (*Emberiza citrinella*) may be taken as an example of this section, which also contains, among other species, the Ortolan (*Emberiza hortulana* of Linnæus, Ortolan Bunting of Latham) and the Cirl-Bunting (*Emberiza Cirlus* of Linnæus).

II. The Spur-Buntings (Bruans Eperonniers, Plectrophanes of Meyer).

This section has the back claw long and but very slightly arched. The species composing it live always on the ground in open places. Their moult is simple and ordinary, but the colours of the plumage change considerably by rubbing and the action of the air and light, so that their summer dress appears very different from that which these birds assume in the autumn.

The numerous genera into which, as we have seen, the genus *Fringilla* of Illiger has been subdivided, do not accord with M. Temminck's views; and as this excellent ornithologist has as much practical experience as any of those who have made this interesting branch of natural history their study, and perhaps more, we think it right to put the student in possession of his opinions on this subject.

M. Temminck, then, thus defines his genus Gros-Bec (*Fringilla* of Illiger):—Bill short, strong, convex, straight, and completely conical; upper mandible swollen as it were, a little inclined towards the point, without any arête, and with the upper part depressed, often prolonged into an angle between the frontal feathers. Nostrils basal, round, placed near the front, behind the horny elevation of the swollen part of the bill, partially hidden by the feathers of the front. Feet with the tarsus shorter than the middle toe; the anterior toes entirely divided. Wings short; the second or third quills graduated, the third or fourth longest. Tail varying in form.

These birds, according to M. Temminck, feed on all sorts of seeds and grains, which they open with the bill, at the same time rejecting the husk; it is only very rarely that insects are added to this diet. They inhabit all the countries of the globe, but particularly the regions of the torrid zone and warm latitudes. They raise many broods annually, collect together in numerous flocks, and migrate in associated flights. Of all the winged class they are, after the Pigeons and Gallinaceous Birds, the most easily domesticated. The greater number of foreign species and some European undergo a double moult. When this takes place, the male assumes in winter the livery of the female. The young of the year differ from the old ones before the autumnal moult; but after that period it becomes impossible to distinguish them.

Upon this extensive genus M. Temminck proceeds to remark that methodists have essayed to class these birds in many genera, under the designations of *Strobilophaga*, *Coccothraustes*, *Fringilla*, *Passer*, *Pyrgita*, *Vidua*, *Linaria*, and *Carduelis*. The manners of all these birds being, with some slight shades of difference, absolutely the same, it is impossible, in his opinion, to have recourse to the invention of new names as the means of subdividing this great group. M. Temminck declares that he took the greatest pains to compare more than a hundred foreign species with our indigenous species, and the result of this examination confirmed him in the conclusion that there exists a gradual passage, without any demarcation, from one species to another. This natural series has, he observes, been recognised by Illiger, who unites all these birds with a thick and conical bill ('à bec gros et conique') in one great genus under the name of *Fringilla*, comprising the Bullfinches (*Pyrrhula*) therein. M. Temminck, however, thinks that these last ought to be classed in a distinct genus, in consequence of the form of the bill, certain habits, and perhaps also with reference to the countries they inhabit. The genus *Loxia*, he remarks, has been restored by Illiger to the limits assigned to it by Brisson; and he adds that he (M. Temminck) has separated from the genus *Loxia* of Linnæus a species singularly characterised by the form of the bill, under the name of *Psittirostra*. M. Cuvier, he goes on to observe, has, in the 'Règne Animal,' indicated, rather than established characteristically, many genera and sub-genera. M. Cuvier allows that there is a gradual passage, without any assignable interval, from the Linnets to the Grosbeaks. The species of his genus *Vidua*, or Widow-Birds, are distinguished by some of the upper coverts of the tail being excessively elongated in the males. This distinction, available for recognising the males only, disappears in the moult; for in winter they have no conformation of the tail differing from that of the females; and at that season it would be difficult to pronounce whether they were Linnets, Sparrows, or Finches (Pinsons). M. Temminck agrees that to facilitate the methodical arrangement of the great number of species composing this genus, it is necessary to have recourse to an artificial classification, by the aid of which the species may be easily found. The simplest method, in his opinion, is to form three sections in the genus *Fringilla*, under indications which have more or less reference to the three different groups of bills, which may be separated into *Laticones*, *Brevicones*, and *Longicones*. In the first section may be comprised, he thinks, the greater number of the pretended *Loxiæ* of authors, some soi-disant Bengalies, and the Sparrows (Moineaux), which resemble ours in the colours of their plumage; in the second, some Sparrows (Moineaux) of authors, the Finches (Pinsons), the Linnets (Linottes), and those indicated as Widow-Birds (*Viduæ*), Bengalies, and Senegalies; in the third the Tarins, some Senegalies, and the Chardonnerets.

I. *Laticones.*

Bill large, convex, more or less swollen on the sides.

The Grosbeak, Haw-Grosbeak, or Hawfinch (*Loxia Coccothraustes* of Linnæus, *Fringilla Coccothraustes* of Temminck), is placed by that author at the head of this section, which contains, among other species, the Green Grosbeak or Greenfinch (*Loxia chloris* of Linnæus, *Fringilla chloris* of Temminck) and the Common Sparrow.

II. *Brevicones.*

Bill in the shape of a cone, more or less short, straight, and cylindrical, often conical throughout.

M. Temminck commences this section with the Chaffinch. The Linnets also belong to it.

III. *Longicones.*

Bill in the form of a straight cone, long, and compressed; points of the two mandibles sharp.

The Citril Finch (*Fringilla Citrinella* of Linnæus) appears at the head of this section, which also comprises, among other species, the

Siskin (*Fringilla spinus* of Linnæus), the Lesser Redpole, and the Goldfinch.

In the second volume of his 'Classification of Birds,' Mr. Swainson makes the *Coccothraustinæ* the typical group, a sub-family composed of the Hawfinches, Weavers, Goldfinches, and Linnets. They live entirely upon trees, and have the bill very strong and entire. Genus, *Coccothraustes;* sub-genera, *Pyrenestes* (Sw.), *Coccoborus* (Sw.), *Coccothraustes* (Briss.), *Spermophaga* (Sw.), *Dertroides* (Sw.). Genus, *Ploceus;* sub-genera, *Vidua* (Cuv.), *Euplectes* (Sw.), *Ploceus* (Cuv.), *Symplectes* (Sw.). Genus, *Amadina* (Sw.) (Bengaly); sub-genera, *Estrelda* (Sw.), *Amadina* (Sw.), *Spermestes* (Sw.), *Erythura* (Sw.), *Pytelia* (Sw.). Genus, *Tiaris* (Sw.); Genus, *Carduelis* (Sw.); Genus, *Linaria* (Briss.); sub-genera, *Linaria*, *Leucosticte* (Sw.), *Chloris* (Sw.). The second or sub-typical group he makes to contain the *Tanagrinæ*. Genus, *Tardivola* (Sw.); Genus, *Tanagra* (Linn.); sub-genera, *Pitylus* (Cuv.), *Tanagra* (Linn.), *Ramphopis* (Vieill.). Genus, *Phœnisoma* (Sw.); sub-genera, *Lamprotes* (Sw.), *Phœnisoma* (Sw.), *Tachyphonus* (Vieill.), *Leucopygia* (Sw.). Genus, *Nemosia* (Vieill.); Genus, *Aglaïa* (Sw.); sub-genera, *Euphonia* (Sw.), *Tanagrella* (Sw.). Genus, *Pipillo* (Vieill.); sub-genera, *Arremon* (Vieill.). The third consists of the *Fringillinæ*, or True Finches, differing materially from the two former; their bills are generally smaller, but more perfectly conic; seeds form their food almost entirely; and they chiefly live upon the ground. Genus, *Pyrgita* (Antiq.); sub-genera, *Aimophila* (Sw.), *Leucophrys* (Sw.). Genus, *Fringilla* (Linn.); sub-genera, *Passerella* (Sw.), *Fringilla*, *Zonotrichia* (Sw.), *Ammodramus* (Sw.), *Chondestes* (Sw.). Genus, *Emberiza;* sub-genera, *Emberiza* (Linn.), *Fringillaria* (Sw.). Genus, *Leptonyx* (Sw.); sub-genus, *Melophus* (Sw.). Genus, *Plectophranes* (Meyer); sub-genera, *Miliaria* (Sw.), *Plectrophanes* (Meyer). Genus, *Agrophilus* (Sw.). The fourth contains the *Alaudinæ*. Bill much more slender than in any of the preceding; hind claw always more or less lengthened. Genus, *Alauda* (Linn.); Genus, *Calendula* (Linn.); sub-genera, *Myafra* (Horsf.), *Braconyx* (Brachonyx ?) (Sw.). Genus, *Agrodroma* (Sw.); Genus, *Macronyx* (Sw.); Genus, *Certhilauda* (Sw.). Mr. Swainson considers that the *Alaudinæ* pass into the fifth, the *Pyrrhulinæ* (Bullfinches). Genus, *Pyrrhulauda* (Smith); Genus, *Pyrrhula;* sub-genera, *Crithagra* (Sw.), *Spermophila* (Sw.). Genus, *Psittirostra* (Temm.); Genus, *Corythus* (Cuv.); Genus, *Hæmorrhous* (Sw.).; Genus, *Loxia* (Linn.).

In Mr. Darwin's collection is a series of Ground-Finches, so peculiar in form that Mr. Gould was induced to regard them as constituting an entirely new group, containing fourteen species, and appearing to be strictly confined to the Gallapagos Islands. He proposes the following generic names for them: *Geospiza*, *Camarhynchus*, *Cactornis*, and *Certhiada*. Mr. Darwin remarks that these birds are exclusively confined to the Gallapagos Islands; but their general resemblance and their indiscriminate association in large flocks rendered it almost impossible to study the habits of particular species. In common with nearly all the birds of these islands, they are so tame that the use of the fowling-piece in procuring specimens was quite unnecessary. They appeared to subsist on seeds deposited on the ground in great abundance by a rich annual crop of herbage. ('Zool. Proc.,' 1837.)

Having thus endeavoured to give the student a general sketch of this family of birds, and the views of some of the leading ornithologists with regard to them, we conclude with a list of the species found in the British Islands as given in Mr. Yarrell's work on 'British Birds.'

Passer montanus, the Tree-Sparrow; *Fringilla montana*, Penn.; *Pyrgita*, Fleming; *Passer montanus*, Selby; *Fringilla montana*, Jenyns; *Pyrgita*, Gould; *Fringilla*, Temm. [PASSER.]

Passer domesticus, the House-Sparrow; *Fringilla domestica*, Penn.; *Pyrgita*, Fleming; *Passer domesticus*, Selby; *Pyrgita*, Gould. [PASSER.]

Coccothraustes chloris, the Green-Finch or Grosbeak; *Loxia chloris*, Penn.; *Coccothraustes*, Fleming; *Fringilla*, Jenyns. [COCCOTHRAUSTES.]

Coccothraustes vulgaris, the Haw-Finch; *Loxia Coccothraustes*, Penn.; *Fringilla Coccothraustes*, Jenyns; *Caccothraustes vulgaris*, Gould; [COCCOTHRAUSTES.]

Carduelis elegans, the Goldfinch; *Fringilla Carduelis*, the Goldfinch; *Carduelis elegans*, Selby and Gould. [CARDUELIS.]

Carduelis spinus, the Siskin; *Fringilla spinus*, Penn.; *Carduelis*, Selby and Gould; *Fringilla*, Jenyns and Temm. [CARDUELIS.]

Linota cannabina, the Common Linnet; *Fringilla Linota*, Linnet-Finch of Penn.; *F. cannabina* Red-Headed Finch; *F. Linota*, Brown Linnet; *F. cannabina*, Greater Redpolo; *F. Linota*, the Linnet of Bewick; *Linaria*, of Selby; *Fringilla*, Gros-Bec Linote of Temm. [LINOTA.]

Linota canescens, the Mealy Redpole of Gould and Bonaparte; *L. borealis*, Macgillivray; *Fringilla*, Gros-Bec Boreal, Temm. [LINOTA.]

Linota linaria, the Lesser Redpole, or Common Redpole; *Fringilla linaria*, Lesser Red-Headed Finch of Pennant; Rose-Linnet of Fleming; *Linaria minor*, Lesser Redpolo Linnet of Selby and Gould; Gros-Bec Sizerin of Temminck. [LINOTA.]

Linota montium, the Mountain Linnet, or Twite; *Fringilla montana*, Twite-Finch of Penn. and Gould; *F. montium* of Montague and Jenyns; Mountain Linnet of Bewick. [LINOTA.]

Pyrrhula vulgaris, the Bulfinch. It is *Loxia pyrrhula* of Pennant, Montague, and Bewick; *Pyrrhula vulgaris* of Fleming, Selby, Jenyns, and Gould. [BULLFINCH.]

Pyrrhula enucleator, the Pine Grosbeak; *Loxia enucleator* of Penn.; *Corythus*, Common Hawfinch of Fleming and Gould; *Pyrrhula*, Pine Bulfinch of Selby and Jenyns.

FRITILLA'RIA, a genus of Plants belonging to the natural order *Liliaceæ*. It has a perianth of 6 leaves with a nectariferous depression at the base of each; the style trifid at the apex; the seeds flat. Of this genus the Common Fritillary, *F. meleagris*, is a native of Great Britain. It has a single-flowered leafy stem, the leaves all alternate and linear-lanceolate. It inhabits meadows and pastures, and is found throughout Europe. It has flesh-coloured flowers, with numerous dark and sometimes white spots. *F. montana*, grows in the mountainous districts of Europe. It has the 2 floral leaves, opposite, and distinct from those of the stem. *F. pyrenaica* of Sibthorp, the *F. tulipifolia* of Bieberstein, is found in Greece. The species are often cultivated in gardens on account of their flowers. They blossom in April and May, and will grow in any common garden soil. (Babington, *Manual of British Botany;* Koch, *Flora Germanica.*)

FROG. [AMPHIBIA.]

FROGSBIT. [HYDROCHARIS.]

FROND, a botanical term intended to express such organs as are composed of a stem and a leaf combined. The leaves of ferns and palms were thought to be of this nature. It is not now however applied to the leaves of palms, but is still employed to express those leaf-like expansions of the *Cryptogamia* which bear the organs of reproduction.

FRONDICULARIA. [FORAMINIFERA.]

FRONDIPORA. [MILLEPORIDÆ.]

FRUIT. In botanical language, that part of the plant which in the early stages of its growth is called the Pistil [PISTIL], and which contains the ovules or seed-buds, becomes the Fruit, when the ovules by the presence of the embryo, are changed into seeds. The Style and Stigma, when they still remain, retain their names, but the Germen is called the Pericarp. In this sense, there are of course some plants which have no Fruit, because they are not provided with a Germen; these therefore have naked Seed-Buds, or Ovules, and also naked Seeds (Semina nuda); such are *Coniferæ*, *Cycadaceæ*, and *Loranthaceæ*. But there are some plants in which the germen is easily destroyed, so that the seed-bud is developed without an envelope to the seed: these, in order to distinguish them from the former, are termed Semina denudata, as in *Leontice* and *Peliosanthes*.

Fruits may be divided, according to the analogy of the flower, into Naked and Covered (Fructus nudus et Fructus tectus), according as the germen only appears to exist, as in *Lilium*, or as this is surrounded by other floral parts, as in *Nicandra*. When one pistil is developed into a fruit it is called a simple fruit (fructus simplex), as in *Nigella;* when several, a compound or multiple fruit (fructus multiplex), as in *Ranunculus*.

The parts of the Fruit are the Pericarp, the Spermophore, the Funiculus, and the Pulp.

The Pericarp is the transformed germen: sometimes it is united with the other persistent parts of the pistil, style, and stigma. The latter are seldom of particular importance; and all that need be said of them is that they are sometimes retained, as in *Papaver*, or they are more developed, as in *Pulsatilla*. The forms of the pericarp are exceedingly diversified, but admit of no general definition: they frequently exhibit hairs, prickles, protuberances, and membranous expansions (alæ), prominent ribs (costæ or juga), and pits in their interspaces (valleculæ), &c. The pericarp essentially determines the varied appearances of the fruit, by its diversity of structure. The parenchyma of the germen is developed in various ways. In the simplest cases, we find in the mature pericarp only the epidermis of both surfaces, and between these a uniform layer of parenchyma, without vascular bundles, as in the lower *Araceæ*, or traversed by a few simple bundles. In other cases only the epidermis of the external surface is perceptible, whilst the entire parenchyma, with the epidermis of the inner surface, is succulent or fleshy, as in *Atropa;* or it may be, that under the epidermis of the outer surface some layers of cellular tissue are woody, whilst the underlying are fleshy; in both cases very frequently passing without determined boundary into the pulp.

In many other cases four layers are distinctly discernible, and have been named, counting from without inward, Epicarp, Mesocarp, (also Sarcocarp, or Flesh, 'caro'); and the two inner undistinguished coats, the Endocarp. Those varieties of structure in the fruit are most important which cause the peculiar solutions of the continuity in the fully mature condition. Hence we obtain two comprehensive classes of fruits, according as their construction causes a separation into individual parts or not. The latter may be termed the berry-like, and the former the capsular. The capsular are again divided into two groups, according as the pericarp either opens and suffers the seed to escape—Capsules with their portions called valves; or separates into individual parts, which do not again open, but firmly inclose the seed—Splitting Fruits (Schizocarps), and their parts called Mericarps. The Berry-like Fruits are also sub-divided into three groups, according as the inner layers are the more tough and solid, and the outer the more fleshy and juicy—Stone Berries (Drupes); or the reverse—True Berries (Baccæ); or, lastly, all the layers appear thin and dry, or leathery (Achænia). All these forms may, with the germen from which they arise, be superior or inferior, one- or many-celled, or one- or many-seeded: which only require to be noticed when deviations in the structure of the germen have arisen through abortion, being otherwise self evident.

a. The Capsular Fruits occur in the most diverse families. The mode of bursting (Dehiscence) is especially to be observed. The simplest process is an apparent wholly irregular tearing open at any place, as in *Nicandra*: usually however the form of this dehiscence is very regular, even though it may be confined to a small part of the fruit, as in *Papaver*, *Antirrhinum*, &c.

The solution of continuity is either vertical or horizontal: in the latter case, the upper part forms a kind of cover upon the under, and the capsule is termed circumscissile. In the first case, the pericarp, &c. falls away in more or fewer separate pieces, which are termed valves. In many-celled fruits the valves may separate entirely from the persistent septa, as in *Cobœa scandens* (dehiscentia septifraga); or the septa may split into two lamellæ, and each valve may bear one of these lamellæ on each of its margins (dehiscentia septicida, valvulæ margine septiferæ); or the septa may remain undivided, adherent to the middle of the valves (dehiscentia loculicida, valvulæ medio septiferæ). If in any of these kinds of dehiscence a stalk-like mass of cellular tissue remains standing in the axis of the fruit, it is called the Columella.

From what has been said, it is sufficiently evident that these solutions in the continuity are not at all dependent upon the original composition. Such a relation has been assumed; and to the line in the external circumference of the pericarp, where the edges of real or pretended carpels have become blended, the term 'dorsal suture,' has been applied, while the term 'ventral suture' designates merely the line where the margins of one and the same carpel or similar part have become blended.

In the generality of capsular fruits, the above-mentioned four layers of the pericarp may be distinguished from each other; but they are usually very thin and membranous or leathery, or more rarely woody.

b. The Schizocarps, or Splitting Fruits, are usually distinguished chiefly according to the direction in which the cleft occurs. This is either parallel with the axis of the fruit, or perpendicular to it, that is, the solution of continuity is either vertical or transverse. In both, the separate parts are usually only one-seeded. In the first case the separate parts are sometimes named Cocci or Mericarps, in the last case Joints or Articulations; and they are distinguished, according to the texture of their layers, as dry, coriaceous, and succulent. The first (the mericarps) are proper to the families *Rubiaceæ*, *Euphorbiaceæ*, *Labiatæ*, *Boraginaceæ*, *Geraniaceæ*, *Tropæolaceæ*, *Malvaceæ*, *Umbelliferæ*, &c., &c.; the last (the joints) to some of the *Leguminosæ* and *Cruciferæ*. In the first a columella is not uncommon.

c. The Stone-Berries, characteristic of the *Amygdaleæ*, but also presented in other families, owe their peculiarity to the remarkable diversity in the structure of their layers, and indeed of the parenchyma layers, the inner of which are always hard, and often woody; whilst the outer are fleshy or coriaceous: both are developed in a greater thickness than usual.

d. The True Berries, predominating in the families of *Grossulariaceæ*, *Passifloraceæ*, *Cucurbitaceæ*, and the *Araceæ*, and occurring occasionally in many other families, depend essentially on the fleshy or juicy texture of the inner layers of the pericarp: this condition often exists to the extent of a dissolution into single cells, tumid with fluid, whilst the external layers are solid, and sometimes even woody, as in *Lagenaria*.

e. The Achænia, with always thin dry layers, not usually distinguishable, characterise the families of the Grasses, *Cyperaceæ*, *Cupuliferæ*, *Compositæ*, and *Dipsaceæ*, predominate in the *Dryaceæ* and *Ranunculaceæ*, and occur singly in other cases. They are one-celled and one-seeded, generally originally, but sometimes, as in the *Cupuliferæ*, through abortion of cells and seed-buds.

With regard to the Spermophore it may be remarked, that in the dehiscence of the fruit portions of cellular tissue are separated from the valves or septa, to which the seeds remain suspended, and which have been termed Spermophores. In these separations sometimes actually independent organs become solved from their union with others, as in *Cruciferæ*, and sometimes merely pieces of independent organs become detached, as in the *Asclepiadaceæ*.

The Pulp in the fruit assumes two conditions; on the one hand it passes into the loose cellular tissue of the pericarp in the true berries, as in *Solanum*; and on the other into the subsequent products of the funiculus; namely, into the aril in its widest sense, as in *Arum*, and probably into the true aril, as in *Ribes*.

The Funiculus exhibits manifold varieties, such as hairs, warty expansions among the seeds, membranous, continuous, or lobed envelopes of the seed (arils), and so forth.

There are often parts external to the germen, which are persistent till after the maturation of the seed [SEED], and they often undergo many changes; and when they become fleshy they assume the appearance of fruits. They are called Spurious Fruits. The most remarkable example of this is seen in the case of the fruit of the Fig (*Ficus*), in which the peduncle or receptacle swells up and incloses the true fruits. The pedicel in *Hovenia dulcis* also swells up and assumes the form of a fruit. In the Pine-Apples (*Ananassa*) the bracts enlarge and become the part eaten. In the Mulberry (*Morus*) the perianth is the fleshy part; in the Bladder-Campion (*Cucubalus baccifer*) the calyx enlarges; in *Mirabilis* it is the corolla; and the hips of the Rose (*Rosa*) are the dilated disc, whilst in the Strawberry (*Fragaria*) the sweet juicy part is the receptacle.

The terms applied to the fruits of plants by botanists are very numerous. The same kind of fruit has frequently several names, whilst the same name has been applied to several different kinds of fruits. The following enumeration of some of these terms is given by Schleiden in his 'Principles of Scientific Botany,' whose remarks on this subject deserve careful attention from those interested in the further development of this subject:—

Enumeration of the Various Forms of Fruit.

I. Seed naked (*Semen nudum*).
- *A.* Seed solitary.
  - 1. *Bacca.* Seed inferior. Ex. *Viscum.*
  - 2. *Sphalerocarpium.* Seed with a fleshy aril. Ex. *Taxus.*
- *B.* Fructifications.
  - 3. *Strobilus.* Spikes with woody spermophores. Ex. *Pinus.*
  - 4. *Galbulus.* Capitula with confluent fleshy bracts. Ex. *Juniperus.*

II. Simple Fruits (*Fructus simplex*).
- *A.* Capsule (*Capsula*).
  - † Superior.
  - 5. *Capsula circumscissa.*
  - 6. *Utriculus*, Gärtner, No. 5. One-celled, originating from a carpel; few-seeded. Ex. *Chenopodium.*
  - 7. *Pyxidium*, No. 5. One- or many-celled, formed of several carpels; many-seeded. Ex. *Hyoscyamus.*
  - 8. *Folliculus.* One-celled, or many-celled, one-valved. Seeds on the two margins of the valve. Ex. *Pæonia.*
  - 9. *Conceptacula.* Two disunited *folliculi* with one separating spermophore. Ex. *Asclepias.*
  - 10. *Legumen.* One-celled, 1-seeded, or many-seeded, two-valved. Seeds on the two borders of one fissure. Ex. *Pisum.*
  - 11. *Siliqua.* Two-celled, two-valved, separating from the persistent spermophore, forming a Septum (*Replum*). Ex. *Matthiola.*
  - 12. *Silicula.* A very short *Siliqua.* Ex. *Thlapsi.*
  - 13. *Ceratium.* A *Siliqua* in some *Fumariaceæ* and *Papaveraceæ.*
  - 14. *Rhegma.* Elastically two-valved (?), dehiscing from a *Columella.* Ex. *Euphorbia.*
  - 15. *Capsula.* One-celled or many-celled, many-seeded, dehiscing by valves or pores, *Primula*, *Antirrhinum.*
  - †† Inferior.
  - 16. *Diplotegia*, Desvaux. Inferior capsule, dehiscing by pores. Ex. *Campanula.*
- *B.* Splitting Fruits (*Schizocarpium*).
  - 17. *Cremocarpium* (?). In *Umbelliferæ*, *Rubiaceæ.*
    - *a. Mericarpia.* The separate parts of the *Schizocarpium.*
  - 18. *Carcerulus.* In *Tropæolaceæ*, *Malvaceæ.*
  - 19. *Achænium.* In *Boraginaceæ*, *Lamiaceæ.*
- *C.* Stone Fruits (*Drupa*).
  - 20. *Drupa.* Originally one-celled, 1-seeded, 2-seeded. The *Mesocarpium* fleshy, the *Endocarpium* woody. Ex. *Amygdalus.*
  - 21. *Tryma*, (imagined to be) one-celled by suppression in *Juglans.*
- *D.* Berry (*Bacca*).
  - 22. *Bacca.* Many-celled, inferior. Ex. *Ribes.*
  - 23. *Nuculanium.* Many-celled, superior. Ex. *Vitis.*
  - 24. *Pepo.* One-celled, inferior. Ex. *Pepo.*
  - 25. *Hesperidium.* Coriaceous portion, strictly separated from the pulp. Ex. *Citrus.*
  - 26. *Amphisarca.* Woody toward the exterior. Ex. *Crescentia.*
- *E.* Closed Fruit (*Achænium*).
  - 27. *Achænium* (*Auctorum*), *Cypsela* (Lindley). One-celled, one-seeded, not blended with the seed. Ex. *Compositæ.*
  - 28. *Glans.* Through abortion one-celled, one-seeded. Ex. *Corylus.*
  - 29. *Caryopsis.* One-celled, one-seeded (imagined to be) blended with the seed. Ex. the Grasses.
  - 30. *Samara.* Two-celled, winged. Ex. *Acer.*
  - 31. *Carcerulus.* Many-celled, not winged. Ex. *Tilia.*

III. Multiple Fruits (*Fructus multiplex*).
- *A.* Several Achænia.
  - 32. *Etærio.* If wholly free. Ex. *Ranunculus.*
  - 33. *Syncarpium.* If connected. Ex. *Magnolia.*
- *B.* Several Berries.
  - 34. *Etærio.* Connected. Ex. *Rubus.*

IV. Fructifications (*Fructus compositus*).
- *A.* *Capitula.* With a flat or cup-shaped fleshy peduncle.
  - 35. *Syconus.* Ex. *Ficus*, *Dorstenia.*

B. Spikes with fleshy bracts and perianths.
36. *Sorosis.* Ex. *Ananassa, Morus.*
C. a. Spikes with woody bracts.
37. *Strobilus.* Ex. *Betula.*
b. Spikes with woody bracts and perianths.
38. *Strobilus.* Ex. *Casuarina.*
V. Spurious Fruits (*Fructus spurius*).
39. *Cynarhodon.* Free one-seeded Achænia, surrounded by a fleshy disc. Ex. *Rosa.*
40. *Pomum.* Many-seeded Achænia in one circle, blended with the fleshy disc. Ex. *Malus.*
41. *Balausta.* Many-seed Achænia in two circles, blended with the fleshy disc. Ex. *Punica.*
42. *Diclesium.* Achænia enclosed in a hardened perianth or corolla. Ex. *Spinacia, Mirabilis.*
43. *Sphalerocarpium.* Achænia inclosed in a drupaceous perianth. Ex. *Hippophäe.*

FUCACEÆ, a natural order of *Algæ*, or olive-coloured inarticulate Sea-Weeds, whose spores are contained in spherical centres, immersed in the substance of the frond. The root has almost always a conical disc, rarely branching or creeping. The fronds are of an olive-brown or olive-green colour, becoming darker in drying; of a tough leathery substance, and fibrous texture, tearing lengthwise with facility; dichotomous or pinnate; rarely irregularly branched, but very variable in habit. In the simpler kinds (*Splancnidium*) there is no distinction into parts (as stem, leaves, receptacle), but the fructification is equally dispersed through all parts of the plant; in others (*Durvillæa, Sarcophycus*) there is a stem ending in a phyllo-caulon or leaf-like frond, through which the fructifications are scattered; in others (*Himanthalia*) there is a simple frond of small size, and a branching receptacle of fructification resembling a frond; in others (*Fucus, Cystoseira*) there is a branching or imperfectly leafy frond, some portions of whose branches finally swell and are converted into receptacles of fruit; and, finally, in the most perfect kinds (*Sargassum, Marginaria*) there is a branching frond, with well-formed mostly distinct and nerved leaves and receptacles, from their origin set apart as organs of fructification (not formed by swellings of the old branches), developed either in the axils or along the edges of the leaves or branches. Air-vessels are present in almost all, either in bladdery swellings of the stem and branches, as in *Fucus*, or as distinct organs, as in *Sargassum*, stalked, and mostly springing from the same part as the fructification. Receptacles of the fruit, mostly more or less distinguishable from the barren portion of the frond, swollen, succulent, often filled with slimy mucus, either formed from the metamorphosed ends of the branches, or evolved from the axils or sides of the branches or leaves. These receptacles are pierced by minute pores, which communicate with small spherical chambers formed by an introflexion of the walls of the receptacle at the points where they occur. The little chambers (called Conceptacles by some writers, Scaphidia by others) contain sometimes spores, or reproductive bodies, analogous to the seeds of more perfect plants; sometimes antheridia, supposed to be analogous with stamens; sometimes both organs in the same chamber. The spores spring from the sides of the chamber. One of the surface-cells being fertilised, gradually enlarges, projects from the wall of the chamber, becomes more or less obovate, and finally is converted into a perispore, or membranous transparent case, in which is contained the spore or spores. These last are formed from the matter contained within the enlarged cell. At first the contents are nearly fluid, of a pale olive colour; gradually they acquire density, become darker, and at length are consolidated into a single sporule, as in *Cystoseira, Halidrys*, &c., or formed into two, four, or eight sporules, as in *Fucus, Himanthalia*, &c. The antheridia are borne on branching jointed threads, called Paranemata, which rise, like the spores, from the walls of the conceptacle, and commonly fill the greater part of its cavity. Each antheridium is an oblong cell, forming the terminal articulation of the branches of the paranemata, and is filled with minute orange-coloured bodies called Sporidia (by J. Agardh), closely resembling the zoospores of the lower *Algæ*, and like the latter endowed with spontaneous movements. The motive organs are vibratory hairs, or cilia, with two of which each little body is furnished.

The *Fucaceæ* are easily known from all other Olivaceous Sea-Weeds by a character at once natural and easily ascertained, namely, the position of their spores within little hollows sunk in the substance of the plant, and communicating with the surface by a pore. The order is represented in most climates, from high northern and southern latitudes to the equator. Very few species vegetate in the polar regions of either hemisphere. In the north the species of *Fucus* and *Himanthalia* alone reach to the Icy Sea; and in the Antarctic Ocean the order is limited to *Durvillæa* and to *Scytothalia Jaquinotii*, a fine *Alga* allied to sub-tropical forms. The British species, excluding three doubtful natives, are but fourteen; yet from the strictly social habits of several of them, they cover more surface of tidal rocks than all the other *Algæ* put together. It is these plants which impart the deep brown colour to the belts of rocks exposed on the recess of the tide.

The following is a synopsis of the British genera of these plants:—

Sargassum.—Branches bearing ribbed leaves. Air-vessels simple.

Halidrys.—Frond linear, pinnate, leafless. Air-vessels divided into several cells by transverse partitions.

Cystoseira.—Root scutate. Frond much branched, bushy. Receptacles cellular.

Pycnophycus.—Root branching. Frond cylindrical. Receptacles cellular.

Fucus.—Root scutate. Frond dichotomous. Receptacles filled with mucus, traversed by jointed threads.

Himanthalia.—Root scutate. Frond cup-shaped. Receptacles (frond-like) very long, strap-shaped, dichotomously branched.

I. SARGASSUM.—Frond furnished with distinct, stalked, nerved leaves, and simple axillary stalked air-vessels. Receptacles small, linear, tuberculated, mostly in axillary clusters or racemes. Seeds in distinct cells. The generic name is from Sargazo, the Spanish term for masses of sea-weed found floating in the ocean in some latitudes.

1. *S. vulgare;* and
2. *S. bacciferum*, though both of them have been found cast on our shores, have no just claim to a place in our British Flora, being natives of the tropics, occasionally driven, with other tropical productions, by the force of the western currents on our Atlantic coasts. The species of this genus are found over a wide extent of ocean, and have been generally called 'Gulf-Weed.' They appear like floating meadows in the midst of the ocean, sometimes for miles in extent, and probably support a larger number of living creatures than the most productive pasturage in Great Britain. Myriads of Mollusks, *Radiata*, Fishes, and *Crustacea* may be seen playing about in these masses; and the abundance of Zoophytes which find shelter in such situations can hardly be estimated. The weed is eaten in China. In the East it is used in salads, and forms a pickle.

II. HALIDRYS has compressed linear fronds, pinnated with distichous branches. The air-vessels are lanceolate, stalked, divided into several cells by transverse partitions. The receptacles are terminal, stalked, cellular, pierced by numerous pores, which communicate with immersed spherical conceptacles.

H. siliquosa has linear very narrow branches, compressed linear lanceolate air-vessels, slightly constricted at the septa, mucronate. It is found on rocks and stones in the sea, at and below half-tide level.

III. CYSTOSEIRA has a frond furnished with branch-like leaves, becoming more filiform upwards. The air-vessels are simple, arranged within the substance of the branch-like leaves consecutively. The receptacles are cylindrical, more or less lanceolate, tuberculated, and terminal. The seeds in distinct cells. The name is derived from two Greek words, signifying a little sac and a chain.

C. ericoides has a thick woody short stem, cylindrical, and beset with numerous slender filiform branches, variously divided, and densely clothed with small spine-like awl-shaped ramuli (or leaves). It is found on rocks in the sea, and has the property of being iridescent when under water in a growing state. In drying it becomes nearly black, and does not adhere to paper.

The other British species of this genus are—*C. granulata, C. fœniculacea, C. barbata*, and *C. fibrosa.*

IV. PYCNOPHYCUS has a root composed of branching fibres. The frond is cylindrical and dichotomous. The air-vessels, when present, innate and simple. The receptacles terminal, cellular, pierced by numerous spores, which communicate with immersed spherical conceptacles, containing in the lower part of the receptacles parietal simple spores, and in the upper tufted antheridia. The name is from two Greek words, signifying thick sea-weed.

P. tuberculatus is found in rock-pools, on the recess of the tide, near low-water mark. It is better known by the name of *Fucus tuberculatus.* It is very different in many respects from *Fucus* proper. When dry it becomes very brittle and black.

V. FUCUS has a plane compressed, or cylindrical frond, linear, dichotomous, coriaceous. The air-vessels, when present, are innate in the frond, simple, and large. The receptacles terminal (except in *Fucus nodosus*), turgid, containing tubercles imbedded in mucus, and discharging their seeds by conspicuous pores.

F. vesiculosus is common on all our sea-shores. It is the Sea-Ware, Bladder-Fucus, Kelp-Ware, Black-Tang of Scotland, and sometimes Lady-Wrack. In Gothland, according to Linnæus, it is Swine-Tang, because boiling it and mixing it with a little coarse flour they give it to their hogs. In the Hebrides, cheeses are dried without salt, being covered with the ashes of this plant, which abounds with salt. In Scania it is used as thatch and fuel. The root is a hard flat disc. The fronds are from 2 to 3 feet in length. The air-vessels, as large as nuts, are in pairs; the receptacles, in pairs, and often forked, terminate in branches. There is a variety of this which is often called *Fucus Balticus.* It is found among grass and moss in marshy ground occasionally overflowed by the tide. Lightfoot mentions that during the snow-storms in the Highlands, the red deer descend from the wild mountains to feed on this sea-weed. He mentions also that the saponaceous mucus of the vesicles has been recommended to remove glandular swellings, and the calcined powder of the plant is said to be valuable as a dentifrice. The great use now made of this weed, as well as of others, is in the manufacture of kelp and iodine.

F. ceranoides is sometimes called the Horned Fucus. It resembles the preceding species, but is much thinner and more transparent, the midrib is more distinct, and the leafy part is narrower, although it is a more graceful plant than *F. vesiculosus*.

F. serratus, Serrated Sea-Weed, is very common on all our sea-shores. It is perennial. The frond differs from the preceding by being serrated. In Scotland it is called Black-Wrack, or Prickly Tang. It is not so rich in kelp and iodine as the others. It is useful as manure. In Norway it is used as food for cattle, mixed with meal. The Dutch use it to cover their crabs and lobsters, to keep them alive and moist, preferring it to any other because it is destitute of that mucus which causes them to ferment and putrefy. It is a handsome species, the fronds on both sides being dotted with pencil-like clusters of whitish capillary fibres, and the fronds being often broad.

F. nodosus, Knobbed-Wrack. The root is a large hard conical mass, from which spring several branches, from 2 to 4 or 6 feet in length. It is called in some places Yellow Wrack. In England it is often called Sea-Whistle, in consequence of the custom among children of converting the vesicles into whistles. The air-vessels are called crackers; for when thrown into the fire they make a slight explosion.

F. Mackaii is found on muddy sea-shores, usually in land-locked bays and among boulders. The frond is from 6 to 10 inches long, densely tufted; branches crowded, spreading, compressed at the base, cylindrical upwards. The vesicles wider than the frond. In substance leathery; when dry somewhat horny.

F. canaliculatus, Channelled Fucus. This is abundant on rocks on the sea-shore near high-water mark. It is perennial. Cattle are exceedingly fond of it, and never fail to browse on it in winter as soon as the tide leaves it within their reach.

VI. Himanthalia has coriaceous orbicular top-shaped fronds. Very long strap-shaped receptacles, repeatedly forked, spring from the centre of the frond, filled with mucus, traversed by jointed fibres, and pierced by numerous pores, which communicate with immersed spherical conceptacles, containing either parietal spores or antheridia.

H. lorea is common on rocky sea-shores. It seems difficult to determine as to the duration of this plant. Some regard it as annual, as the thongs are produced every year; but others say the long thongs are only receptacles, that the cup-shaped disc is perennial, and that this part is truly the plant. The cup-shaped frond which adheres firmly to the rock is more than an inch in diameter. The branches or receptacles are in Scotland about 6 feet long. In Cornwall they are sometimes 20 feet long. The name in English signifies sea-thongs. The fruit consists of tubercles immersed in the fronds, and these tubercles discharge their seeds by pores, which give the thongs a spotted appearance. This is remarkably the case when, after lying on the shore for some time, every pore is covered with a yellow dot, which is the mucus of the plant discharged in the death-struggle which goes on, when, torn from the rock and tossed out by the waves, it lies withering in the open air. Dr. Neill mentions that in the north of Scotland a kind of sauce for fish or fowl, resembling ketchup, is made from the cup-like or fungus-like fronds of this sea-weed.

(Harvey, *British Marine Algæ*; Landsborough, *British Sea-Weeds*.)

FUCHSIA, a genus of Plants belonging to the natural order *Onagraceæ*. This genus was named after Leonard Fuchs, one of the earliest of modern cultivators of botany. He was born at Wembdingen, in Swabia, in 1501, where he kept a school, but was made a professor at Ingoldstadt in 1521, whence he removed to Anspach, and subsequently to Tübingen, where he died in 1556. He wrote a great work on Botany, with the title 'De Stirpium Historia Commentarii Insignes,' which was published in folio at Basle in 1542. This work was illustrated with wood-cuts executed by Spücklin of Strassburg. These engravings are admirably done, and some of them would bear comparison with the wood-engravings of the present day. This work has been translated into almost every European language, and many editions of the original Latin have been published. It was however only a part of a great work which the author had on hand; and when he died he left about 1500 drawings, with which he had intended to illustrate a second and third part.

The genus *Fuchsia* has the tube of the calyx adhering to the ovarium at the base, and drawn out at the apex into a cylindrical 4-cleft tube, whose lobes soon fall off; four petals alternating with the lobes of the calyx, and inserted in the upper part of the tube, very rarely wanting; eight stamens; the ovary crowned by an urceolate gland; the style filiform, crowned by a capitate stigma; the berry oblong or ovate-globose, 4-valved, 4-celled, many-seeded. The species are shrubs, usually with opposite leaves, and axillary 1-flowered pedicels, which are sometimes disposed in racemes at the tops of the branches. The flowers, which are very elegant, are usually drooping, of a red colour, rarely white, sometimes 5-cleft, and decandrous. There are few genera of plants in which, under cultivation, there is a greater tendency among the flowers to sport; and thus they frequently afford the most interesting and important illustrations of the doctrines of morphology.

F. microphylla, the Small-Leaved Fuchsia, has pubescent branches, with opposite, small, elliptic-oblong, acutish, toothed, glabrous, a little ciliated leaves; the pedicels axillary, shorter than the flowers; the calyx funnel-shaped, with ovate-acuminated lobes; retuse toothed petals. This plant is a native of the volcanic mountain Jorullo, in Mexico. It has a scarlet calyx, with deep red petals, and blossoms from June to September. It was first described by Humboldt, Bonpland, and Kunth, in their work on American Plants, and was first introduced into England in 1828. It is now one of the most commonly cultivated of the species in the gardens of Great Britain.

F. coccinea, the Scarlet Fuchsia, has glabrous branches, opposite leaves, or three in a whorl, ovate, acute, denticulated, on short petioles; the pedicels axillary, drooping, longer than flowers; the lobes of the calyx oblong, acute, exceeding the petals, which are obovate and convolute. It is a native of Chili, in marshy districts, and is found as far south as the Strait of Megalhaens. It is one of the species earliest introduced into the gardens of Great Britain; and was first described by Aiton in the 'Hortus Kewensis.' It has a scarlet calyx, with violaceous petals. In its native countries the wood is used for obtaining a black colouring-matter, and the leaves and young branches are used as medicine. It grows and blossoms in the open air in the summer, but requires protection in the winter.

F. corymbiflora (*corymbifera*, Walpers), the Corymbose Fuchsia, has branches somewhat tetragonal; leaves opposite, petiolate, oblong lanceolate, almost entire; the pedicels three, nearly terminal, nodding, shorter than the flowers; the lobes of the calyx lanceolate-acute, twice the length of the petals, which are oblong-lanceolate. This elegant shrub is about 6 feet in height, and is a native of Peru about Chincao and Muna, in shady groves. It has scarlet flowers 2 inches long, which hang down in beautiful corymbs. The berries are ovate-oblong, of a reddish-purple colour. This plant, although described by Ruiz and Pavon, was only introduced into our gardens about the year 1838, and is now justly considered the most ornamental species of this beautiful genus.

F. arborescens, the Arborescent Fuchsia, has glabrous branches, the leaves three in a whorl, oval-oblong, acuminated at both ends, petiolate, quite entire; the panicle terminal, trichotomous, nearly naked; the calyx funnel-shaped, with the lobes ovate, acute, and spreadingly reflexed, also the petals. It is a native of Mexico, and has been introduced into this country since 1824. It is a larger plant than most of the species, not unfrequently attaining a height of 15 feet.

F. gracilis, the Slender Fuchsia, has the branches finely pubescent; the leaves opposite, glabrous, on long petioles remotely denticulated; the pedicels axillary, nodding, as long as the calyx; the lobes of the calyx oblong-acute, exceeding the petals, which are convolute and retuse; the stigmas undivided. This plant was first described by Lindley, and has been grown in this country since 1823. The flowers have a scarlet calyx and purple petals.

About fifty species of *Fuchsia* have been described, and many more than those named above have been introduced into the gardens of Europe. They are all American plants. They thrive well in a rich light soil; and young cuttings of them strike root readily in the same kind of soil when covered over with a hand-glass. Many will grow in the open air in this country throughout the winter with a very slight protection. When planted in clumps on lawns or borders they should be mulched at the root to preserve them through the winter. In the spring, when the ground is cleared, the stems of the preceding year, which are generally dead, should be cut off quite close to the ground, to allow the young shoots to spring from the root.

(Don, *Dichlamydeous Plants*; Walpers, *Repertorium Botanices Systematicæ*, vol. ii.; Bischoff, *Lehrbuch der Botanik*.)

FUCHSITE, a Green Mica from the Zillerthal, containing 4 per cent. of oxide of chromium. From the crystallisation of mica, two additional species have been made out of the old species so called. The common mica has an oblique prism for its primary. Many micas when in perfect crystals have the form of a hexagonal prism, and but one axis of polarisation; this last fact proving the primary to be a regular hexagonal prism. This species is properly distinguished, and has been called hexagonal mica.

FUCOIDÆA. [Pseudozoaria.]

FUCOIDES, the vague title for many Fossil Marine Plants, given by Brongniart. They are mostly referred to other genera by later writers. There is a peculiar geological interest in the distribution of Fucoids, since Dr. Forchhammer ('Reports to the British Association,' 1844) has shown the probability of their influence in the metamorphism of rocks.

FUCUS. [Fucaceæ.]

FULGORA, a genus of Hemipterous Insects, popularly known as Lantern-Flies, on account of their power of emitting light in the dark. The *Fulgora laternaria* of Linnæus is the type. It is a native of South America. The form of this insect is very remarkable, on account of the regular inflated and enormous head, out of which the phosphorescence was said to proceed. The celebrated Mademoiselle Merian was the first naturalist who observed this property, and in her great work on the Insects of Surinam she gives an account of her discovery. Strange to say, however, many travellers deny altogether the luminosity of the Lantern-Fly, whilst others as strongly assert it. It is probably a sexual peculiarity, and only exhibited at certain periods in the animal's life.

FULGURITES are vitrified sand-tubes, supposed to have originated from the action of lightning; they are called by the Germans Blitzröhre.

These tubes were discovered in the year 1711 by the pastor Herman, at Massel, in Silesia; and they were again discovered in 1805 by Dr. Hentzen, in the heath of Paderborn, commonly called the Senne, and he first attributed their formation to the agency of lightning.

These tubes have since been found in great numbers at Pillau, near Königsberg, in Eastern Prussia; at Nietleben, near Halle on the Saale; at Drigg in Cumberland, and some other places.

At Drigg, the tubes were found in the middle of sandbanks, 40 feet high, and very near the sea. In the Senne they were most commonly found on the declivities of mounds of sand, about 30 feet high; but sometimes in cavities, which are stated to have been hollowed in the heath, in the form of bowls, 200 feet in circumference, and 12 to 15 feet in depth.

These tubes are nearly all hollow. At Drigg their external diameter was $2\frac{1}{2}$ inches; those of the Senne, reckoning from the surface, are from one quarter to seven lines internal diameter; but they narrow as they descend lower, and frequently terminate in a point: the thickness of the tube varies from half a line to an inch.

These tubes are usually placed vertically in the sand; but they have been found at an angle of 40 degrees. Their entire length, judging from those which have been extracted, is from 20 to 30 feet; but frequent transverse fissures divide them into portions from half an inch to 5 inches in length.

Usually there is only one tube found at a place; sometimes however, at a certain depth, this tube divides into two or three branches, each of which gives rise to small lateral branches, from an inch to a foot in length; these are conical, and terminate in points, inclining gradually to the bottom.

The internal part of the tubes is a perfect glass, smooth and very brilliant, resembling hyalite. It scratches glass, and gives fire with steel. All the tubes, whatever may be their form, are surrounded by a crust composed of agglutinated grains of quartz, which have the appearance, when examined by a glass, of having undergone incipient fusion.

The colour of the internal mass of the tubes, and especially that of the external parts, depends upon the nature of the sandy strata which they traverse. In the superior beds, which contain a little soil, the exterior of the tubes is frequently black; lower down the colour of the tube is of a yellowish-gray; still lower, of a grayish-white; and lastly, where the sand is pure and white, the tubes are almost perfectly colourless.

That the cause of these tubes is correctly attributed to lightning is shown by some observations presented to the Royal Society, in 1790, by Dr. Withering. On opening the ground where a man had been killed by lightning, the soil appeared to be blackened to the depth of about 10 inches; at this depth, a root of a tree presented itself, which was quite black; but this blackness was only superficial, and did not extend far along it. About two inches deeper, the melted quartzose matter began to appear, and continued in a sloping direction to the depth of 18 inches; within the hollow part of one mass, the fusion was so perfect, that the melted quartz ran down the hollow, and assumed nearly a globular figure.

Professor Hagen, of Königsberg, has made a similar observation. In the year 1823 the lightning struck a birch-tree at the village of Rauschen. On cautiously removing the earth, Professor Hagen found, at the depth of a foot, the commencement of a vitrified tube, but it could not be extracted from the sand in pieces of more than two or three inches in length; the interior of these fragments was vitrified, as usual; several were flattened, and had zigzag projections.

It is also to be observed, that Saussure found on the slaty hornblende of Mont Blanc small blackish beads, evidently vitreous, and of the size of a hemp-seed, which were clearly the effects of lightning. Mr. Ramond has also remarked on the Pic du Midi, in the Pyrenees, some rocks, the entire face of which is varnished with a coating of enamel, and covered with beads of the size of a pea; the interior of the rock is totally unchanged.

FULICA. [RALLIDÆ.]

FULIGULA, FULIGULINÆ. [DUCKS.]

FULLERS' EARTH, a Mineral product, formerly much used in the fulling of cloth, whence it derives its name. It occurs massive, and is usually of a greenish-brown or dull gray colour; sometimes it is nearly of a slate colour. It is opaque, dull, and its specific gravity is 1·8 to 2·2. Greasy and soft, yielding to and polished by the nail. Fracture uneven, earthy; in water it breaks down into a soft pulpy mass. Before the blow-pipe it fuses into a white blobby glass.

It is found at Nutfield, near Reigate, in Surrey, and occurs in regular beds near the summit of a hill, between beds of sand or sandstone, containing fossil wood, cornua ammonis, &c. There are two distinct beds of Fullers' Earth; the upper has a greenish colour, is 5 feet in thickness, and rests upon the other, which has a bluish tint, and is 11 feet thick; in these beds, but especially in the latter, there are found considerable masses of sulphate of barytes, frequently in regular crystals. Fullers' Earth is also found in Kent, Bedfordshire, Bath, Nottinghamshire, and Sussex. It is met with also in Styria, Saxony, and some other places.

According to Dr. Thompson's analysis, this substance consists of—

Silica	44
Alumina	23·06
Lime	4·08
Magnesia	2
Protoxide of Iron	2
Water	24·95
	100·09

Dr. Thomson observes that, allowing the lime, magnesia, and protoxide of iron to be in the state of silicates, and as mere accidental constituents, Fullers' Earth is a hydrous bisilicate of alumina, consisting of two equivalents of silica, one equivalent of alumina, and two equivalents of water.

FUMA'RIA (from the Latin *Fumus*, smoke, in allusion to the unpleasant smell which it exhales; the French, with the same meaning, call it Fumeterre, and hence our English word Fumitory), a genus of plants the type of the natural order *Fumariaceæ*. It has 4 petals, the upper one spurred at the base, 2 sepals, diadelphous stamens, fruit indehiscent and 1-seeded. There are about 12 species of *Fumaria*, which are smooth slender herbs, with small racemose white or purplish flowers.

Corydalis lutea.

1, the two sepals, stamens, and pistil; 2, a longitudinal section of the ovary; 3, a longitudinal section of a seed, showing the ovary: all more or less magnified.

F. capreolata, Rampant Fumitory, has ovate acute sepals, toothed, as broad as the corolla, and half its length; globose emarginate fruit; bracts about a third shorter than the fruit-stalks. It is a climbing plant, and has cream-coloured flowers tipped with red or purple.

F. officinalis, Common Fumitory, has ovate lanceolate sepals, narrower and two-thirds shorter than the corolla, broader than the pedicel; fruit globose, truncate, slightly emarginate; bracts two or three times shorter than the fruit-stalks. It grows in corn-fields and cultivated land throughout the world, and is plentiful in Britain. The flowers are of a pale-red colour, deep-red at the summit, with a green keel to the upper and under petals. The leaves are succulent, saline, and bitter, and the expressed juice is recommended as a remedy in cases of hypochondriasis and cachectic states of the body. It is said to correct acidity and strengthen the stomach. Boerhaave used to prescribe it in black jaundice and bilious affections. It has also gained some reputation as a cosmetic. Dr. Cullen recommends an infusion of the leaves in cutaneous disorders, and he also advises the use of it as a tonic whenever bitter remedies are desirable.

F. micrantha is distinguished by its sepals being orbicular dentate, broader than and nearly half as long as the corolla; fruit globose, slightly pointed; bracts longer than the fruit-stalks. This species is found both in England and Scotland, and has pale purple flowers in dense spikes.

F. parviflora has ovate sepals as broad as the corolla and about two-thirds shorter. It greatly resembles *F. officinalis*, but is smaller in all its parts. The flowers are of a pale-red colour. It is found in Kent, and is also very common in the East Indies, where it is used as a medicine. The leaves have a bitter taste, and Dr. Whitlaw Ainslie mentions it in his 'Materia Medica of Hindostan.' The Mohammedans employ it as a diuretic, and in maniacal cases.

F. Vaillantii has its sepals narrower than the pedicels, and many times shorter than the corolla. Globose fruit, scarcely pointed; bracts about as long as the pedicels. The flowers are mostly white with a purple tip. This is a British species, and is also found in sandy fields in the neighbourhood of Paris and Montpelier.

With the exception of one or two species, this genus seems hardly worth cultivation, having but a weedy and insignificant appearance. Such however as have a climbing tendency, look well if sown under a hedge and allowed to twine amongst the stems and branches.

(Don, *Dichlamydeous Plants;* Babington, *Manual of Brit. Bot.*)

FUMARIACEÆ, *Fumeworts,* a small natural order of Exogenous Plants, consisting of slender-stemmed herbaceous plants, many of which scramble up others by aid of their twisting leaf-stalks. They are rather succulent, with watery juice. Their leaves, which have no stipules, are repeatedly divided till the terminal lobes become small ovate leaflets; their flowers, which are extremely irregular, consist of 2 membranous minute ragged sepals, 2 exterior distinct linear petals, and 2 others, which hold firmly together at the points; there are 6 stamens united into two parcels, and the ovary is a 1-celled case with 1 seed or many seeds, whose placentation is parietal; finally, the seeds consist principally of albumen, in which there ripens a very small embryo. *Fumaria officinalis* is one of the commonest of weeds. Many are objects of cultivation by the gardener for the sake of their showy flowers; all are reputed diaphoretics. They only inhabit the cooler parts of the world, alike avoiding extremes of heat or cold. Two species are found in the Cape of Good Hope. The affinities of the order are with *Droseraceæ, Papaveraceæ, Berberidaceæ,* and *Brassicaceæ.* There are 15 genera and 110 species described.

FUMITORY. [CORYDALIS; FUMARIA.]

FUNA'RIA, a genus of Plants belonging to the natural order *Musci*, or Mosses. It has terminal fruit-stalks, with an oblique double peristome, both the outer and the inner having each 16 teeth, the inner ones opposite to those of the outer. There are three British species of this moss: *F. hygrometrica, F. Muhlenbergii,* and *F. hibernica.*

F. hygrometrica has the leaves very concave, ovate, apiculate, entire, the nerves excurrent; the fruit-stalk curved, flexuose. It is a native of Great Britain, and is found by waysides and under hedges, especially on spots where a wood-fire has been burning on the ground. It may be thus constantly found on the site of gipsies' encampments. It has obtained its specific name *hygrometrica* from its fruit-stalk having the property of twisting in different directions when moisture is applied to it. On taking a dry fruit-stalk into the hand and moistening the lower part with the finger, the capsule will turn itself from the right to the left by making two, three, or more turns; on moistening the upper part in the same manner, the capsule turns itself more rapidly in an opposite direction. Under the microscope the stalk exhibits an elongated cellular tissue twisted in a spiral form. The cellular tissue is not however turned uniformly, but at two-thirds of the length of the stalk it commences to assume a straighter form, and at the upper part it again turns itself, but more acutely, in an opposite direction to that of the lower part. The cause of the turning in two different directions depends on this structure of the cellular tissue. The capsule turns itself in an opposite direction to the spires which are moistened, and the circumstance of its turning more rapidly on the upper end being wetted, depends on the more acute angle made by the upper spires. The dryness of the fibres is not the cause of this phenomenon, as the green fruit-stalks, although perfectly dried, do not turn when moistened. The movements in this case are probably owing to the shortening of the vegetable fibre by the contact of moisture. In the green stalk the thick fluid contents of the cells leave a precipitate when they are dried, which fills them up and prevents the action of moisture upon them. In the ripened stalk this precipitate is dissolved and absorbed, and otherwise applied; and thus the cells, being empty, act like hollow tubes.

(Lankester, *On the Structure of Funaria Hygrometrica; Ann. of Nat. Hist.* vol. iv.; Link, *Report on the Progress of Botany,* 1841, translated for the Ray Society, vol. i.; Hooker and Taylor, *Muscologia Britannica.*)

FUNGI. Under this name botanists comprehend not only the various races of mushrooms, toadstools, and similar productions, but a large number of microscopic plants forming the appearances called mouldiness, mildew, smut, rush, brand, dry-rot, &c. Notice has been occasionally taken of these plants under their respective heads; in this place some general account will be given of them as a large natural order.

Nothing can well be more different than the extremes of development of *Fungi*, if the highest and the lowest forms are contrasted; as for example, the large fleshy *Boleti*, which grow on the trunks of trees, and the microscopic mould-plants, composed of threads much too delicate to be distinguished by the naked eye. Nevertheless, it turns out upon inquiry that the latter is only a simple form of the former, or, in other words, that a *Boletus* is merely an enormous aggregation of the vegetable tissue constituting a *Mucor*, developed upon the same plan, subject to the same influences, possessing a similar chemical character, and propagating by means which are altogether analogous.

Viewed with reference to their whole extent, the plants of this order may be described as cellular or filamentous bodies, having a concentric mode of development, often when full grown almost amorphous, nourished through their thallus (spawn or mycelium), living in air, propagated by colourless or brown spores, and sometimes inclosed in asci and destitute of green gonidia.

That they are cellular or filamentous may be easily ascertained by examining them with even an indifferent microscope; perhaps they might be even simply described as cellular, for their filamentous tissue seems nothing but cells drawn out. Sometimes, as in the genus *Uredo*, they consist of spheroidal cells, having little connection with each other, each cell containing propagating matter, and all separating from each other in the form of a fine powder when ripe: the smut in corn is of this nature; or, as in *Cylindrosporium*, the cells are truncated cylinders not adhering, so far as we can see, and separating in like manner when ripe. In plants of a more advanced organisation, as the genus *Monilia*, the constituent cells are connected in series, which preserve their spherical form, and also contain their own reproductive matter; while in such plants as *Aspergillus* the cells partly combine into threads forming a stem, and partly preserve their spheroidal form for the fructification. (*Fig.* 24.) From adhering in simple series, the structure of *Fungi* advances to a combination of such series into strata, whence result the various kinds of dry-rot—thick leathery expansions developing amidst decaying timber; a more complicated form is thence produced in the form of puff-balls, truffles, sclerotiums, and the like, in which a figure approaching that of a sphere is the result, the reproductive cells being indiscriminately confused in the interior of such plants; and finally, the organisation is so much complicated that, independently of a mere aggregation of tissue, we find envelopes of various kinds for the protection of the propagating mass, as in *Agaricus* and *Geastrum*, and special receptacles for the propagating matter, as in *Boletus* and numerous others.

It is probable however that in all *Fungi*, and certain that in most of them, the first development of the plant consists in what we here call a filamentous matter, which radiates from the centre formed by the spore (or seed), and that all the cellular spheroidal appearances are subsequently developed, more especially with a view to the dispersion of the species. We purposely say dispersion, not multiplication; for it is certain that the filamentous matter is quite as capable of multiplying a fungus as the cellular or spheroidal. This is partly proved by the common Mushroom (*Agaricus campestris*), whose filamentous matter is commonly sold under the name of spawn for the artificial multiplication of that species in gardens; and more completely by some recent experiments of M. Audouin, who found that the *Botrytis Bassiana* would inoculate caterpillars and other larvæ as readily by minute portions of its spawn as by its spores or seed-like spheroidal particles. Although however there seems so much reason to ascribe the presence of a filamentous spawn to all *Fungi*, yet it is seldom seen by the ordinary observer; for it develops out of sight, under ground, in the midst of the decaying matter on which *Fungi* so often appear, or through the very substance of living matter; and it is only the aggregation of spheroidal matter which we see. It would appear that for the growth of the former darkness is necessary, and that the latter is stimulated into existence by the action of a feeble quantity of light. To apply to these parts familiar and equivalent names, we should say that the stalk or stem radiates in dark damp situations where it is buried from sight, and that the spheroidal part or fructification alone is able to develop beneath the light of day. The spawn of the mushroom is its stem; the mushroom itself is the fructification of the plant.

It is generally believed that spiral cells are unknown in *Fungi;* Corda however, in his microscopical work on these plants, figures them in the genus *Trichia*, calling them Elaters, and thus assigning them a nature analogous to that of the organs known by the same name in *Jungermanniaceæ* and *Marchantiaceæ.* They were first detected by the younger Hedwig. Berkeley has also detected them in the genera *Batarrea* and *Podaxon.*

The concentric growth of the filamentous stem or spawn of *Fungi* may generally be witnessed in damp cellars, when they begin to grow without impediment upon the walls or decaying wood. Nothing is more common in such situations than to see a beautiful white flocculent matter, which a breath almost will dissipate, spreading from a centre nearly equally in all directions; such appearances, formerly called Byssi, have been ascertained to be the spawn of various kinds of *Fungi*, the fructification of which is probably never developed. Evidence of the existence of a similar mode of growth may be found when the spawn itself is not visible, as in fields where *Fungi* so often spring up in circles or rings; this arises from their stem having originally spread circularly from its point of origin, and thrown up its fructification at the circumference of the circle so formed.

As *Fungi* spring up in great numbers where there is decaying animal or vegetable matter, it has been supposed that the cells of vegetables or animals grow into these forms of life. But that they are not equivocally generated is sufficiently proved by each species having its own particular kind of seed or spore; a provision that would be perfectly unnecessary if the species sprang up out of decaying matter by the mere action of particular combinations of external forces. To assert the existence of fortuitous creations in this class of plants is contrary not only to analogy but to the plainest evidence. The experimental observer may indeed discover that *Fungi* will regularly develop in one kind of chemical mixture and not in another. Dutrochet, for example, found that, if he acidulated a weak solution of white of egg, different species of *Monilia* rapidly formed upon it; while, if he rendered such a solution slightly alkaline, the genus *Botrytis* made its appearance; and that the solution in its simple state, neither alkalescent nor acidulated, produced no *Fungi*—a remarkable circumstance enough. But it would be too much to infer from such an experiment "that invisible germs of a filamentous plant may be created by the chemical action of an acid or an alkali on organic matter dissolved in water, and that they develop by virtue of the vital action which would be the necessary attribute of the chemico-organic molecular compound." On the contrary, the experiment only showed that the seeds of *Fungi*, like those of other plants, require special soils in which to grow; that *Botrytis* will not grow in acid mucilage, nor *Monilia* in alkaline, nor either in mucilage in a neuter state. This is only what happens in plants of a more highly-organised nature. Who ever saw the horned-poppy of the sea-shore growing spontaneously in an inland field, the marsh-marigold on a dry heath, or the reindeer-lichen of Lapland on a heath in Italy? Let any one take a few different kinds of seeds, and commit them all to the ground in the same place; some will spring up and flourish, others will just appear above ground and then perish, others will make an attempt to germinate. This, an every-day event, is a sufficient explanation of the fact elicited by M. Dutrochet's experiment. Every kind of seed has something specific in its nature, in consequence of which it requires particular kinds of soil, and some special combination of heat, light, and moisture, to be roused into a state of vegetation. As to the presence of the seeds of *Botrytis* and *Monilia* in the vessels in which M. Dutrochet's experiments were conducted, it is perfectly easy to conceive that the seeds of such common plants exist everywhere suspended in the air or adhering to the cleanest vessels; they are so numerous as to baffle all powers of calculation; they are so minute as only to become visible when aggregated in masses of many thousands; and so generally dispersed that it is difficult to conceive a place in which they may not be reasonably supposed to exist. The very general existence of dry-rot is no weak evidence of this. [DRY-ROT.]

Fungi are among the most numerous of all plants in regard to genera and species. Mr. Berkeley gives the number of genera as 598, and the species as 4000; but new forms are constantly being added to those already known. It is generally asserted that they are uncommon in tropical countries, but it is doubtful whether this is true, as recent travellers have brought home collections as well as indicated the existence of many forms in tropical climates.

They usually prefer damp, dark, unventilated places, such as cellars, vaults, the parts beneath decaying bark, the hollows of trees, the denser parts of woods and forests, or any decaying matter placed in a damp and shaded situation; and are most especially averse to dryness and bright light. Even when they appear upon the live leaves of trees, the stems of corn, or in similar situations, it is either at the damp and wet season of the year, late in the autumn, or in damp and shaded places; and M. Audouin has shown experimentally that when live insects are attacked by them it is only when they are confined in damp unventilated places. ('Comptes Rendus,' 1837.) In stations favourable to their multiplication they often commit extensive ravages, attacking and destroying timber, and producing decay in all kinds of vegetable matter of a soft and succulent nature; nor is it to dead matter that their ravages are confined. They sometimes fix themselves upon live insects, producing great havoc among the silkworms in the manufactories of Italy, and are probably the cause of a more extensive destruction of such animals than we at present have any idea of. Under the name of mildew and blight they commit excessive damage among living plants, as the farmer and orchardist know too well to their cost.

There is frequently considerable difficulty in distinguishing *Fungi* from the other forms of Cryptogamic Plants. They are distinguished from Lichens by their more fugitive nature, their more succulent texture, their want of a thallus or expansion independent of the part that bears the reproductive matter, but more particularly in their never containing germs distinct from the fructifying bodies of a vegetable germ so constant in Lichens.

From some forms of *Algæ* they differ very little, but the most obvious distinction is their mode of growth. The *Algæ* like the Lichens do not derive their nutriment from the bodies on which they grow, which is the case with all the *Fungi*. There are however certain free forms of *Fungi* which it is difficult to distinguish from *Algæ* by this character; such are the moulds which are developed in ink, milk, and other liquids.

It has been stated that *Fungi* are distinguished from *Algæ* by the absence of spontaneous movements. It is no doubt true that the condition of the protein which is the motile agent in all plants is different in *Fungi* from what it is in *Algæ*, but this is no general distinction. In those *Fungi* which are developed in water, in one instance at least, the *Achlya prolifera*, or *Saprolegnia ferax* [ACHLYA; SAPROLEGNIA], the movements of the spores are as active as in any of the *Algæ*.

"In the simplest form *Fungi* are little articulated filaments composed of simple cellules placed end to end. Such is the mouldiness that is found upon various substances, the mildew of the rose-bush, and in short all the tribes of *Mucor* and *Mucedo*. In some of these the joints disarticulate, and appear to be capable of reproduction; in others spores collect in the terminal joints, and are finally dispersed by the rupture of the cellule that contained them. In a higher state of composition *Fungi* are masses of cellular tissue of a determinate figure, the whole centre of which consists of spores attached, often four together, to the cellular tissue, which at length dries up, leaving a dust-like mass intermixed more or less with flocci, as in the puff-balls, or sporidia, contained in membranous tubes or asci, like the thecæ of Lichens, as in the Sphærias. In their most complete state they consist of two surfaces, one of which is even and imperforate, like the cortical layer of Lichens; the other separated into plates or cells and called the hymenium, to whose component cells, which form a stratum resembling the pile of velvet, the spores are attached by means of little processes, and generally in fours, though occasionally the number is either less or greater." (Lindley.)

The following is Schleiden's account of the development of the organs of reproduction in the *Fungi*:—

"The most simple (*Hyphomycetes*, filamentous *Fungi*) form, at the end of the thread-like cells, narrower protuberances, in each of which a spore is developed: this at length separates, having consequently a double membrane, the cell of the spore itself and the covering (sporangium) arising from the parent cell, as, for instance, in *Penicillium* and *Botrytis*. In others the thread-like cells form a spherical swelling at the extremity, from which project a number of such prolongations, each of which contains a spore, while the whole forms a divided sporangium, as for instance, in *Mucor* and *Penicillium*.

"In others (*Gasteromycetes*, the ventricular *Fungi*) the thread-like cells combine into pointed, or non-pointed, variously-shaped sporocarps; in or upon which are spores, of the development of which we know nothing. After the scattering of the spores, the thread-like cells often remain as tender wool, as in the *Trichiaceæ*, or as a delicate network (capillitium), as, for instance, in *Stemonitis*, *Cribraria*; and the external capsule (uterus peridium) generally composed of fine filamentous cells, is then dissolved, or bursts in different regular ways, as in *Arcyria* and *Geastrum*.

"In the most highly developed *Fungi* (*Hymenomycetes*, membranous *Fungi*), elongated pouch-like cells (probably only the ends of the interwoven filiform fungus-cells, developed into the sporocarps, or cells formed at the ends of these cells) combine by arrangement side by side so closely as to form a membrane (hymenium). Some of the cells of this membrane enlarge considerably (sporangia), and send out from one to six points at their free extremity, in each of which a spore is developed. The filiform cells of the fungus then either form round masses, closed in all round (sporocarps), with cavities in their interior, the walls of which are clothed by the hymenium, or they form definitely arranged columns in *Merisma*, tubes in *Polyporus*, or lamellæ in *Dædalea* and *Agaricus*, which are clothed by the hymenium, as in the *Hymenomycetes*. Of the latter we only know, with any amount of accuracy, the law of development relating to the Toadstools, and more especially that of the *Agaricineæ*. In these latter there are formed, at definite parts of the flocculent mycelium, small hollow heads (volvæ), at the bottom of the cavity of which there grows a corpuscle, shortly pedunculated below, and enlarged into a spherical form at the top. In the lower part of this protuberance a horizontal circular cavity is formed, to the upper surface of which are attached the tubes, lamellæ, &c., which bear the hymenium. The bottom of the cavity is only formed by a membrane (indusium), which is either separated from the pedicel on its further development, or, loosening itself from it and the upper part at the same time, remains as a membranous ring (annulus) upon the stalk. The upper part, which supports the hymenium on its lower surface, dilates subsequently, and appears as an umbrella-like expansion, called the cap (pileus). The whole then breaks through the volva, which is very soon dissolved."

During their growth the same *Fungi* assume very different forms and appearances. It thus happens that the same species has not only been described under different specific names, but even referred to different genera. Fries states that he has traced no less than eight genera of different authors to mere degenerations or imperfect states of *Thelephora sulphurea*. Nees von Esenbeck also states that the same fungoid matter which produces *Sclerotium mycetospora* in the winter, developes *Agaricus volvaceus* in the summer. Professor Henslow has also shown that some of the supposed species of *Uredo* are forms of *Puccinia*, *Aregma*, &c. Kützing, in an essay on the 'Transformations of Plants,' carries his views on this subject very far, and maintains that according to different circumstances the same species will produce *Algæ*, *Fungi*, Lichens, or Mosses.

In the article ENTOPHYTA will be found an account of the plants growing on man and living animals. Many of these are *Fungi*. Professor Balfour, in his 'Class-Book of Botany,' gives the following account of diseases in plants produced by *Fungi*:—

"The attacks of Parasitic *Fungi* cause extensive injury and disease in plants. Some think that the spores of *Fungi* coming into contact with the plant act both as the predisposing and exciting cause of disease; others, perhaps more correctly, think that some change is first produced in the cells of the plant, which enables the spores to find a nidus, and then the disease goes on rapidly, assuming a peculiar type on account of the presence of the fungus: in the same way as vegetable organisms found in diseases of the skin are not to be looked upon as the origin of the disease, but as being developed in textures previously morbid, and as giving often a peculiar character to the disease. Many of the diseases of cultivated crops are attributed to *Fungi*. The spores of *Fungi* are very minute, and are constantly floating in the air. They can easily be applied to the surfaces of plants. When they find an appropriate soil they send out extensive filiform ramifications, which spread under the epidermis of plants, raise blisters, and finally burst forth in the form of orange, brown, and black spots, constituting the fructification. They attack the stem, leaves, flowers, and fruit. Different species are restricted to different plants, and even to different parts of the same plant. The forms which the same fungus assumes seem to vary sometimes according to the plant on which it grows. The disease called Bunt, Smut-Balls, or Pepper-Brand, is occasioned by the plant called *Uredo caries* by De Candolle, and *Uredo fœtida* by Bauer. It attacks the grains of wheat, and may be detected in them in their earliest state. It consists of extremely minute globules of a dark colour, at first attached to a thread-like matter or mycelium. Bauer estimates the diameter of each of the globules at 1-1600th of an inch, and consequently a grain of wheat (reckoned at less than 1-1000th of a cubic inch) would contain four millions such spores. The spores, or powdery matter, have a disgusting odour; hence the specific name given to it. The disease is propagated by contact. Steeping the grain is recommended by some as a means of prevention, and alkaline solutions have been suggested as a remedy. *Uredo linearis*, which is met with also in this disease, is considered as being a young state of the Mildew-plant. Another disease called Smut, or Dust-Brand is caused by a fungus called *Uredo segetum*. It resembles the Bunt-fungus in colour and shape, but its spores are not half so large, and it does not possess a fetid odour. This fungus destroys the ear of corn by first causing the innermost parts of the flower to become abortive, while the pedicels on which these are seated swell and become very fleshy. The fungus then consumes the whole of this fleshy mass, and at length appears between the chaff-scales in the form of a black soot-like powder. It is said also to attack the stem and leaves. When ripe the spores burst through the epidermis, and are dispersed in the form of a black powder like charcoal. The spore is 1-2800th of an inch in diameter. Smut is rare in wheat; it is common in barley, and more so in oats. It is also seen in many grasses, such as *Arrhenatherum avenaceum*. The disease denominated Rust, Red Rag, Red Robin, and Red Gum, is caused by a fungus called *Uredo rubigo*. It forms yellow and brown oval spots and blotches upon the stem, leaves, and chaff. The spores burst through the epidermis and are dispersed as very minute grains. The disease is common in corn and in grasses. Mildew is a disease caused by a fungus denominated *Puccinia graminis*. The ripe spore-cases of this plant are small dark brown club-shaped bodies, their thicker end being divided into two chambers, each filled with minute spores, and their lower end tapering into a fine stalk. The sori, or clusters of spore-cases, burst through the epidermis sometimes in vast numbers. The minute spores seem to enter the plant by the stomata. Some think that they, as well as other minute spores, are absorbed by the roots. The disease attacks wheat. Spring wheat is less liable to this disease than winter wheat, and heavy soils are less subject to it than light ones. Many have supposed that the Barberry is in some way connected with the production of Mildew. This idea has been proved to be erroneous by the experiments of Staudinger, near Hamburg, and of Hornemann at Copenhagen. Unger entertains the idea that blight, mildew, and smut are to be considered as exanthematous diseases of plants caused by the spores of *Fungi* entering the stomata.

"Henslow has shown by experiment, that if the diseased seeds of wheat be steeped in a solution of sulphate of copper they will not produce diseased grain, and that the sulphate of copper does no injury to their germination. The solution used is one ounce of sulphate of copper to a gallon of water for every bushel of wheat. Grain also steeped in hot water does not reproduce these fungoid diseases. In East Lothian, with the view of preventing smut, seed-wheat is often steeped in stale urine, and afterwards some newly-slaked lime is sifted on it. Sometimes a solution of salt is used as a pickle. Fourcroy and Vauquelin ascertained by analysis that blighted wheat contained an acrid oil, putrid gluten, charcoal, phosphoric acid, phosphate of ammonia and magnesia, phosphate of lime, and no traces of starch. As regards Bunt or Pepper-Brand, Henslow remarks, that upon simply immersing the grain in water the infected seeds float, and on the water being poured out, nothing but the sound ones remain in the vessel. This simple process of separation is not however perfectly effective, because in thrashing the wheat many of the infected grains are crushed, and the spores are dispersed in the form of fine powder which adheres obstinately to the sound grain, by means of an oily or greasy matter found in the *Fungi*. In order to detach them thoroughly it has been considered useful to add some alkaline ley to the water in which they are washed. The alkali unites with the oil and forms a soapy matter. Lime has been used for this purpose, common potash, substances containing ammonia, and the liquid from stable dung have also been employed; other matters, as sulphate of copper, act by destroying the vegetating powers of the *Fungi*.

"Mr. Ellis, of Barning, Kent, says that the invariable prevention of smut in wheat is accomplished by scalding the blackest wheat in boiling water, and afterwards dying it with lime. The wheat placed in a colander or in a basket is immersed in boiling water for a few seconds, just long enough to wet it completely, it is then immediately dipped in cold water, afterwards dried with lime, mixed with other wheat, and sown. By this means the wheat was always found to be cured of smut, while the vegetating principle was uninjured, great care being taken that the water was boiling, and the wheat taken out of the water as soon as completely wetted. Mr. Ellis tried an experiment on a bushel of the blackest wheat he could procure, which he divided into sixteen equal parts, sowing them all the same day, but with different treatment. The result at harvest was that the wheat sown without preparation produced 33 black ears out of every 100, while that dipped in boiling water and limed had not a black ear in several thousands which were examined. Many other species of *Uredo* as well as *Ustilago* give rise to diseases. They receive their names from the plants on which they are parasitic, and it seems probable that the same species presents various forms according to the situation in which it grows. *Ustilago Maydis*, a maize smut, is a fungus which gives rise to protuberances on different parts of the maize. The stem, upper leaves, and especially the bracts become immensely swollen when attacked by this disease, and the ovaries, ovules, and male blossoms are not exempt. The parts affected are at first white tinged with red, smooth, and juicy. The cellular tissue increases in volume, and is permeated by radiating hues consisting of mycelium and spores. The spores are twice as large in linear measure as those of the oat smut. At first the small balls contain a dark strong-smelling fluid, but ultimately the masses become dry, and present a quantity of dark dust mixed with irregular threads. *Ustilago vittata* causes disease in grasses in India. The spores of *Ustilago hypodytes* also cause disease in grasses. The spores are black and round, and the disease they occasion is denominated grass-smut. The plant is described by Tulasne. According to Leveillé, the immense quantity of black dust resulting from it in the hay-fields of France produces injurious effects on the haymakers. A species of *Depazea* or *Septoria* sometimes produces disease in the knots of wheat. Various species of *Erysiphe*, such as *E. guttata*, *E. penicillata*, *E. graminis*, *E. adunca*, and *E. bicornis* give rise to kinds of mildew. Erysiphes are often met with in common pea crops. Some say that Oidiums are merely particular states of Erysiphes. The plant producing mildew in the vine is *Oidium Tuckeri* of Berkeley. Other species of *Oidium* probably cause mildew in the peach, rose, hop, pea, and onion. For destroying the mildew in vines sulphur is recommended to be dusted on them. Some also use a solution of hydro-sulphate of lime, made by boiling sulphur and lime in water. A fungus called *Rhizoctoma Mali* is said to grow on the roots of apples, pears, and quinces, and to cause destruction to the trees. Ergot is a monstrous state of the grain in which the enlarged and diseased ovary protrudes in a curved form resembling a cock's spur, hence the name from the French 'ergot,' meaning a spur. The ovary is black externally, spongy internally, and contains much oily matter. Some consider it as produced by the attack of a fungus, which induces a diseased condition in the ovarian cells. The disease is usually met with in rye, and the name of spurred rye is applied to it. It sometimes occurs in wheat and in barley, and it has also been noticed in *Lolium perenne*, *L. arvense*, *Festuca pratensis*, *Phleum pratense*, *Dactylis glomerata*, *Anthoxanthum odoratum*, *Phalaris arundinacea*, and *Alopecurus agrestis*. Ergot consists of a very dense tissue formed by polygonal cells, united intimately with one another, and filled with an oily fluid. It is developed in the unimpregnated ovule of rye, for although extremely dilated by the entophyte and rendered difficult of recognition, the integuments of the ovule increase without completely losing the form which they would have assumed, if they had grown into a true grain, imitating in this respect the ovaries of wheat, in which *Tilletia Caries* (Bunt) has replaced the seed. The solid mass which has been called *Sclerotium clavus* by De Candolle, and the filamentous portion called *Sphacelia* by Leveillé and Fée, and *Ergotætia* by Quekett, are only properly speaking organs of vegetation. The fungus destined to grow from this apparatus is an elegant *Sphæria*, probably that called by Fries *Cordyliceps purpurea*. This plant has been seen by Schumacher in diseased cereal grains, and it has been detected by Roussel in *Sclerotium clavus*, growing on *Bromus sylvaticus* and *Arundo calamagrostis*, and by Dumeril in Ergot of Rye. Tulasne has shown that this *Cordyliceps* is produced from the Ergot when it is allowed to vegetate. Ergot of Grasses and Ergot of *Cyperaceæ*, according to Tulasne, do not belong to the same vegetable species. Rye affected with this disease, when used as bread, is very prejudicial. The Abbé Tessier showed that Ergot caused gangrene in animals that fed on it, and many instances are recorded of gangrene of the extremities occurring in persons who had lived on diseased rye. Ergot is said to prevail in rye grown on wet and stiff land.

"The disease which has recently attacked the Potato in various parts of the world is by many attributed to the attack of *Fungi*. This view has been strongly advocated by Berkeley, who describes the fungus as *Botrytis infestans*. The spores are supposed to enter the stomata and to cause disease in the leaves in the first instance, which afterwards extends to the tubers. The effects produced on the leaves resembled much those caused by poisonous gases, such as hydrochloric, sulphuric, and nitric acids.

"Berkeley attributes the Potato disease entirely to *Fungi*. He states that the disease commenced in the leaves. They were attacked by the mould, which ran its course in a few hours; and from the rapidity of the action, the period for examination of the leaves has often passed over. The fungus generated does not live on decayed or decaying matter, but is one which produces decay, and renders the plants unhealthy. The fungus acts by feeding on the juices of plants, preventing the elaboration of the sap in the leaves, obstructing the admission of air and the emission of transpired fluids. The stem is thus overcharged with moisture, and ultimately rots, while every source of nutriment is cut off from the half-ripe tubers. The atmospheric conditions during the late disease made the fungus spread rapidly.

"While there is no doubt that the *Botrytis* is developed in the progress of the Potato disease, the question arises whether or not it is the originating cause. The view which seems to be most consonant with the phenomena is, that changes are induced in the cells of the potato by cultivation which render the leaves liable to disease. Atmospheric influences are thus enabled to act upon them, so as to cause alterations in their cells; and the attack of a fungus, such as the *Botrytis*, accelerates the morbid action, and causes it to assume a peculiar form. In this way high cultivation, atmospheric influences, and *Fungi*, all contribute to cause disease. In the Potato disease of 1845, Harting says that brown granular matter was deposited in the cells, first in those near the epidermis, then the cellular walls lost their transparency, and the cellules could no longer be isolated by boiling water; next the cell-wall was destroyed, and small cavities were formed in the midst of the tissue, in which were agglomerated grains of starch, and finally parasitic organisms appeared in the cavities. Tho vegetable parasites developed were *Polyactis alba. Fusisporium Solani*, *F. didymum*, *F. candidum*, and *Oidium violaceum*. When the disease had advanced insects were also present.

"Crum attributed the disease of the tubers of the Potato to rupture of the starch-cells, and mixture of their contents with nitrogenous matter, thus causing fermentation, as in the Apple and Grape. Solly objects to the fungus theory of the Potato disease. He says that decaying organic matter is necessary for the growth of *Fungi*. He thinks that the disease is caused by the presence of putrifying azotised matter in the stem, just below the surface of the soil; that this is carried to all parts of the plant, causes a struggle between vital and chemical forces, and induces decomposition by a process of fermeutation. The azotised matter, in a condition to act as ferment, is produced by the state of the season, by deficiency of light, and by other meteorological causes. Analyses show that the constituents of the diseased potato undergo a rapid and important change. Dr. Lyon Playfair and Mr. Phillips found that the amount of albumen and gluten decreased from 2·34 in the sound potato to ·32 in the diseased; and when the disease advanced they finally disappeared.

"Mitscherlich says that the change which cellulose undergoes by the action of a peculiar ferment is characteristic of the substance. This fermenting ageut is obtained when half putrid potatoes cut up into pieces are placed in water, with portions of fresh potatoes, and allowed to stand till the cells of the fresh portions begin to be easily separable. It is also formed, though more slowly, when fresh potatoes cut up are set aside covered with water; the liquid is filtered, and fresh potatoes, cut in slices, added to it; when these are decomposed, a portion of the liquid may be treated with water, and more slices of potato added, which soon become decomposed, and in this manner increase the activity of the liquid. Hence, just as in the fermentation of an infusion of malt, the yeast, the fermentative fungus, becomes augmented, so does the ferment increase. It only acts upou the cellulose, which forms the walls of the starch-cells of the Potato; first the cells separate from each other, so that it furnishes us with a convenient means of obtaiuing the cells with their contents in an isolated state, and facilitating their examination; the walls of the cells are subsequently also dissolved, and the starch-particles fall out: in this manner, in 24 hours, a slice of potato is rendered so soft to a depth of two lines that this portion can be removed by a pair of forceps, the hard mass of the potato lying beneath the softened layer, so that this process takes place successively from the outside towards tho interior; not by the whole of the potato being simultaneously permeated by the ferment to the innermost portion. Exactly the same process as that which we can produce spontaneously, he says, occurs in the Potato disease, which during late years has done so much mischief. In this also the cellulose, and not the starch, is decomposed; and the liquid, which the author had kept for a long time in contact with one of the diseased potatoes, immediately produced the decomposition of a sound one. This decomposition is therefore, he says, not the disease itself but merely the result of it. Its cause undoubtedly depends upon the dying or the previous death of the entire plant, and just as it is well known in the case of other plants that they die when the apices of their roots are too strongly cooled, so may a sudden cold rain following a long warm winter produce a similar condition of the potato plant. It is only after decay has commenced that *Fungi* and insects attack the plant.

"Liebig attributed the Potato disease to diminished or suppressed transpiration, depending upon the hygrometric state of the atmosphere. He refers to Hale's accurate researches in regard to the Hop blight, in which the disease is traced to the want of correspondence between absorption and transpiration, and a consequent stagnation and decomposition of the juices. The same thing, he thinks, takes place in the potato in consequence of cold and an atmosphere loaded with moisture; aud he shows that in 1845 and 1846, when the disease overran Europe, damp, cold, and rainy weather followed heat and drought just at the period of the most luxuriant growth of the potato. The vessels and cells became charged with fluids; and, owing to the checked transpiration, there was stagnation of the sap and death.

"*Fungi* and putrefaction are, according to him, the consequences of the death of the plant. Klotzsch proposes to check the Potato disease by pinching off the extreme points of the branches and twigs to the extent of half an inch dowuwards when the plants have attained the height of six or nine inches above the soil, and to repeat this on every branch or twig on the tenth or the eleventh week. This check to the stem and branches, he thinks, will direct the nutrient matters in the direction of the increase and multiplicatiou of subterranean as well as aërial branches. This leads to iucreased development of tuber, aud strengthens the leaves and stalks. Tombelle Lomba, of Namur, says that he has saved potatoes from disease by cutting off the stems after flowering with a very sharp sickle, and then covering the ground with earth to the depth of not less than an inch and a half. The top dressing thus applied was not disturbed till the potatoes were ripe. The haulm was removed after beiug cut. It is said that the tubers acquired a good size and were of excellent quality. If these facts are true, it would appear that while leaves are necessary to the development of tubers the latter on acquiring a certain size can continue their growth by their own proper and unassisted vitality. The general conclusions to be drawn from all that has been said relative to the Potato disease are, that ohanges are induced in the cells and vessels of the potato by certain obscure meteorological and epidemic causes; that an alteration takes place in the cellulose and in the contents of the cells, which speedily leads to decay; that parasitic *Fungi* find a nidus in the decaying organic matter, so as to accelerate and give a character to the disease; and that, as yet, no remedy has been devised."

For an account of the *Fungi* supposed to produce Dry-Rot in timber see the article DRY-ROT.

In many parts of the world the *Fungi* afford a supply of food to the inhabitants, although not more than half a dozen species aro to be found in the markets of London, and only the common Mushroom, Truffle, and Morel are eaten in Paris; in Italy and other parts of Europe a large number of species are consumed. [AGARICUS.]

Dr. Badham, in his work on the 'Esculent Fuuguses of England,' gives descriptions and drawings of the following species of British *Fungi* as those which may be used as food :—

Agaricus aeris minor, *A. alutaceus*, *A. atramentarius*, *A. campestris*, *A. castaneus*, *A. caudicinus*, *A. comatus*, *A. deliciosus*, *A. emeticus*, *A. exquisitus*, *A. fusipes*, *A. heterophyllus*, *A. melleus*, *A. nebularis*, *A. orcella*, *A. oreades*, *A. ostreatus*, *A. personatus*, *A. piperatus*, *A. procerus*, *A. prunulus*, *A. ruber*, *A. rubescens*, *A. sanguineus*, *A. vaginatus*, *A. violaceus*, *A. virescens*, *A. virgineus*, *A. ulmarius*, *A. Cæsarea*, *Boletus edulis*, *B. luridus*, *B. scaber*, *Cantharellus cibarius*, *Clavaria coralloides*, *Fistulina hepatica*, *Helvella crispa*, *H. lacunosa*, *Hydnum repandum*, *Lycoperdon Bovista*, *L. plumbeum*, *Morchella semilibera*, *Peziza acetabula*, *Polyporus corylinus*, *P. frondosus*, *P. tuberaster*, *Verpa digitaliformis*.

Too great caution however cannot be employed in distinguishing the edible from the poisonous species. Iu the markets of Rome au inspector of Funguses is appoiuted, whose duty it is to examine all *Fungi* exposed for sale, and none are allowed to be sold but with his express sanction. But it would appear, from a case quoted in Lindley's 'Vegetable Kingdom,' that *Fungi* which are usually iuocuous may, under certain circumstances, become poisouous. The fungus consumed in this instance by a family in Cambridgeshire was the *Agaricus personatus*, a species sold in Covent Garden under the name of Blewitts, and which all writers agree in regarding as perfectly froo from danger.

The poisonous principles produced in the *Fungi* have sometimes been employed in medicine, an instance of which is given above in the Ergot. The action of a species of *Bovista* has been found similar to that of chloroform. [BOVISTA.] The *Amanita muscaria* possesses an intoxicating property, and is employed by northern nations as an inebriant. The following is the account of Langsdorf, as given by Dr. Greville :—

"This variety of *Amanita muscaria* is used by the inhabitants of the north-eastern parts of Asia iu the same manner as wine, brandy, arrack, opium, &c., is by other nations. Such *Fungi* are found most plentifully about Wischua, Kamtchatka, aud Willowa Derecona, and are very abuudant in some seasons and scarce in others. They are collected in tho hottest months, and hung up hy a string to dry in the air; some dry of themselves on the ground, and are said to be far more narcotic than those artificially preserved. Small deep-coloured specimens thickly covered with warts are also said to be more powerful than those of a larger size and paler colour. The usual mode of taking the fungus is to roll it up like a bolus and swallow it without chewing, which the Kamatchtkadales say would disorder the stomach. It is sometimes eaten fresh in soups and sauces, and then loses much of its intoxicating property. When steeped in the juice of the berries of *Vaccinum uliginosum* its effects are those of a strong wine. One large or two small *Fungi* are a common dose to produce a pleasant intoxication for a whole day, particularly if water be drunk after it, which augments the narcotic principle. The desired effect comes on from one to two hours after taking the fungus. Giddiness and drunkenness result in the same manner as from wine or spirits: cheerful emotions of the mind are first produced, the countenance becomes flushed, involuntary words and actions follow, and sometimes at last an entire loss of consciousness. It renders some remarkably active, and proves highly stimulating to muscular exertion. By too large a dose violent spasmodic effects are produced. So very exciting to the nervous system in many individuals is this fungus that the effects are often very ludicrous. If a person under its influence wishes to step over a straw or a small stick, he takes a stride or a jump sufficient to clear the trunk of a tree. A talkative person cannot keep silence or secrets, and one fond of music is perpetually singing. The most singular effect of the *Amanita* is the influence it possesses over the urine. It is said that from time immemorial the inhabitants have known that the fungus imparts an intoxicating quality to that secretion, which continues for a considerable time after taking it. For instance, a man moderately intoxicated to-day will by the next morning have slept himself sober, but (as is the custom) by taking a tea-cup of his urine he will be more powerfully intoxicated than he was the preceding day. It is therefore not uncommon for confirmed drunkards to preserve their urine as a precious liquor against a scarcity of the fungus. The intoxicating property of the urine is capable of being propagated, for every one who partakes of it has his urine similarly effected. Thus, with a very few *Amanitæ* a party of drunkards may keep up their debauch for a week. Dr. Langsdorf mentions that by means of the second person taking the urine of the first, the third of the second, and so on, the intoxication may be propagated through five individuals."

Fungi are often phosphorescent. The light given out by species of *Rhizomorpha* [RHIZOMORPHA] in the coal-mines of Dresden is described as giving them the appearance of an enchanted castle. *Agaricus Gardneri*, which grows on a sort of palm called Britada in Brazil, is highly luminous. The same phenomenon has been observed in *A. olearius* in the south of Europe, and in two species of *Fungi* at Swan River. Dr. Hooker describes a luminous fungus as growing upon decaying wood in the forests of the Sikkim Himalaya.

It is generally stated that *Fungi* differ from the rest of the vegetable kingdom, in the absorption of oxygen and the disengagement of carbonic acid gas. In experiments which have been performed, this has been the result; but it is well known that the tissues of *Fungi* are easily decomposable, and it is more probable that the absorption of oxygen and the giving out of carbonic acid gas is the result of decay, rather than of the true growth of the plant. The following substances were found by Payen in his analysis of *Fungi*:—1. Water; 2. Cellulose; 3. Three Nitrogenised Substances; 4. Fatty Matters; 5. Sugar; 6. Volatile Matter; 7. Sulphur; 8. Salts, containing Silex and Potash. These substances are analogous to the ordinary products of the decomposition of water, ammonia, and carbonic acid by deoxidation, and must either be formed by that process in the fungus itself, or taken directly up from the substances on which they grow, by absorption.

A curious fact connected with the development of *Fungi* is the occurrence of vegetable cells, referred to this order, in liquids undergoing fermentation. During the conversion of malt into beer, plant-cells are constantly observed to be present, and these have been described as a plant, under the name of *Saccharomyces Cerevisiæ*. During the preparation of flax, as now carried on at Belfast, Professor Allman has observed present cells resembling those of *Saccharomyces*. Whether these are true plant-cells or not, is still a question; and it is still more a question as to whether they have anything to do with the changes going on in the solutions in which they occur. This point is alluded to in the article ENTOPHYTA. They are probably a result, and not the cause, of fermentation. These cells have not escaped the observation of Schleiden, and the following is his account of them:—

"In the last place, I must mention a highly interesting analogy, which, when more accurately examined, may perhaps one day lead to the most satisfactory explanation of the process of cell-formation—I mean vinous fermentation. We have here a fluid in which sugar and dextrin, and a nitrogenous matter, as a cytoblast, are present. At a certain temperature, which is perhaps necessary to the chemical activity of the mucus, there originates, without, as it appears, the influence of a living plant, a process of cell-formation (the origin of the so-called fermentation-fungus), and it appears that it is only the vegetation of these cells which produces the peculiar changes that occur in the fluid. Whether this organism is really a fungus, is a matter of indifference; but whether it alone, through the activity of its vital processes, determines the process of fermentation, deserves to be accurately determined.

"I will here add my own observations on these fermentation-cells. I bruised some currants with sugar, and, having pressed the juice through a cloth, diluted it with water and filtered through folded paper. The fluid was bright red, quite clear and transparent, and, under the microscope, showed no trace of granules, but presented a number of little drops of a pure clear oil. At the end of twenty-four hours the whole fluid was opalescent, and presented, under the microscope, a number of granules suspended in it. On the second day these granules had greatly increased, and there appeared amongst them perfectly-formed ferment-cells. There also appeared, now and then, vesicles of carbonic acid gas. On the fourth day fermentation was very active. At the bottom of the vessel and on the surface of the fluid, yeast had formed; but these yeasts consisted of single cells, or several attached one to another. In the solitary cells could be observed the way in which one cell was formed from another. The ferment-cells do not in this state permit of a distinction between the contents and the membrane of the cell. In the midst of the cell there is a transparent spot; but whether hollow, or a solid nucleus, I could not decide. The remaining parts appeared entirely homogeneous, yellowish like a nitrogenous substance, sometimes mixed with small solitary granules. In a similar way, a solution of sugar with elder-flowers was examined, and gave similar results. Other results were obtained in the following way:—Pure white protein (albumen) from the white of an egg, was dried, and rubbed down with sugar, and left to ferment: the fluid at first was perfectly clear. On the third day, the small portions of protein, which at the commencement exhibited a sharply angular aspect, assumed partly a granular aspect, and some a more or less rounded form. These globules showed an active molecular movement, and some appeared strung together. On the fourth day there was seen between these granules round or elongated cells, which were either solitary, or arranged together in a line with a tendency to the formation of branched fibres. These cells were not more than one-third of the diameter of ordinary ferment-cells. An active fermentation went on, and gas-bubbles were given out from the protein-granules and the linear cells. Proper ferment-cells did not make their appearance. Fluid albumen, mixed with sugar, and filtered, became thickened on the second day, and contained little granules of albumen (coagulated?). The further phenomena were similar to those exhibited by the preceding, except that there were developed a few true ferment-cells. Protein moistened with water displayed the same appearances as when mixed with sugar and water; ultimately putrefaction came on, and the development of *Infusoria*, but the vegetable formation preceded. There appears to be two very different types of ferment-cells, according as the fluid contains organic acids and essential oils or not. From the phenomena exhibited by the ferment-cells, one might be inclined to regard them as similar to animal-cells, which are formed through a cavity in the cytoblast, and which afford indications of the nucleoli in their highest development. But this analogy is not tenable, and the above observations must be regarded as imperfect. If we take fully-developed ferment-cells, and treat them with ether, alcohol, or caustic alkalies, there will be found in the fluid a number of globular delicate cells, with thin but clearly distinguishable walls, which contain a clear fluid, with here and there very small granules, which, alone or in groups, are attached to the inner surface of the cell-wall, and (almost?) always a large round flat body (a cytoblast?)."

The classification of *Fungi* has occupied the attention of many observers. That of Fries is the foundation of most of the systems adopted by modern writers.

Fries in the first place divides the whole order into four Cohorts, distinguished by the following characters:—

Cohort I. HYMENOMYCETES. A Hymenium present; that is, the fungus opened out into a fructifying membrane, in which the spores (seeds) are placed, usually in the inside of asci (transparent simple cases). The texture wholly filamentous.

Cohort II. PYRENOMYCETES. A Perithecium present; that is, the fungus closed up; then perforated by a hole or irregular laceration, and inclosing a distinct kernel holding asci. Texture obscurely cellular; that of the stroma (receptacle) somewhat filamentous.

Cohort. III. GASTEROMYCETES. A Peridium present; that is, the fungus at first closed up, and containing loose spores having no asci. The texture cellular.

Cohort IV. CONIOMYCETES. Spores naked; that is, the fungus in its elementary state, eventually having the spores quite naked, although they may have been covered at first. The texture between filamentous and cellular; and the thallus often apparently absent.

He then subdivides these cohorts each into four Orders, as follows:—

Cohort I.—HYMENOMYCETES.

Order 1. *Pileati.* The Hymenium on the under side, and having asci. (*Fig.* 1, *Agaricus.*)

Order 2 *Elvellacei.* The Hymenium on the upper side, and having asci. (*Fig.* 2, *Morchella.*)

Order 3. *Clavati.* The Hymenium on both sides, and having asci. (*Fig.* 3. *Clavaria.*)

Order 4. *Tremellini.* Amorphous. The Hymenium confounded with the receptacle. Asci none. Membranous or gelatinous, with a filamentous texture. (*Figs.* 4, 5, *Dacrymyces.*)

Hymenomycetous *Fungi.*

1. *Agaricus odorus*, reduced in size; 2, *Morchella esculenta*, reduced in size; 3, *Clavaria cinerea*, reduced in size; 4, *Dacrymyces stillatus*, growing in wood, natural size; 5, the same magnified.

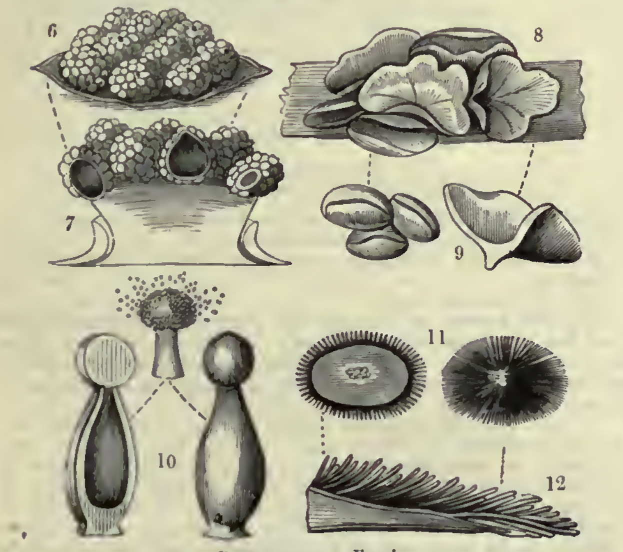
Cohort II.—Pyrenomycetes.

Order 1. *Sphæriacei.* The kernel filled with asci, and deliquescent. (*Figs.* 6, 7, *Cucurbitaria.*)

Order 2. *Phacidiacei.* The kernel filled with asci, and dry. (*Figs*, 8, 9, *Cenangium.*)

Order 3. *Cytisporei.* The kernel filled with naked spore-cases, and disintegrating. (*Fig.* 10, *Sphæronema.*)

Order 4. *Xylomacei.* The kernel filled with naked spore-cases, and dry. (*Figs*, 11, 12, *Actinothyrium.*)



Pyrenomycetous *Fungi.*

6, *Cucurbitaria cinnabarina*, magnified; 7, a section of the same; 8 and 9 *Cenangium ferrugineosum*, magnified; 10, *Sphæronema subulatum*, magnified 11, 12, *Actinothyrium graminis*, magnified.

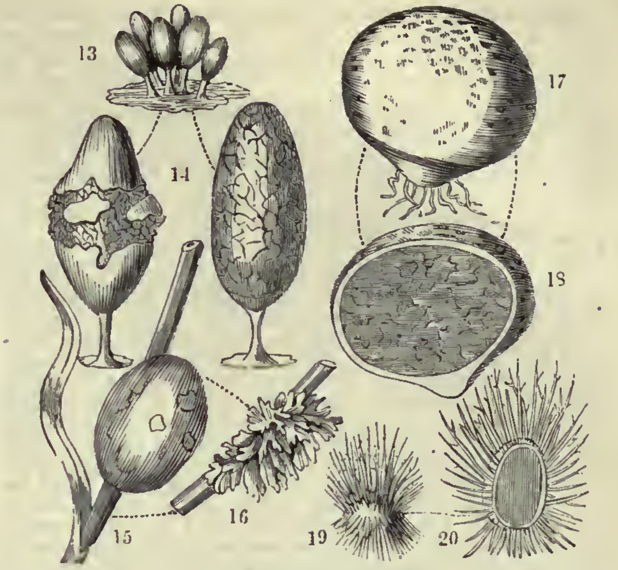
Cohort III.—Gasteromycetes.

Order 1. *Angiogastres.* Spore-cases immersed in a receptacle distinct from the peridium.

Order 2. *Trichospermi.* Spore-cases naked, among filaments distinct from the peridium. (*Figs.* 17, 18, *Scleroderma*; *figs.* 13, 14, *Arcyria.*)

Order 3. *Trichodermacei.* Spore-cases naked, covered by filaments constituting a peridium. (*Figs.* 15, 16, *Spumaria.*)

Order 4. *Sclerotiacei.* Spore-cases immersed in a receptacle constituting the peridium. (*Figs.* 19, 20, *Chætomium.*)



Gasteromycetous *Fungi.*

13 and 14, *Arcyria punicea*, magnified; 15, 16, *Spumaria mucilago*, magnified; 17, 18, *Scleroderma Cepa*, magnified; 19, 20, *Chætomium elatum*, magnified.

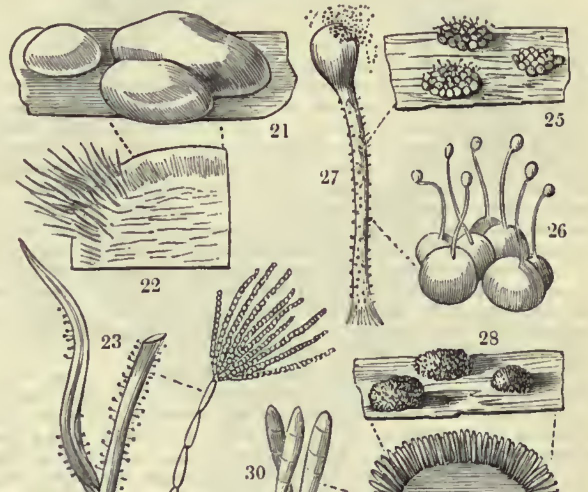
Cohort IV.—Coniomycetes.

Order 1. *Tubercularini.* Spore-cases plunged in an entangled receptacle, upon a free receptacle. (*Figs.* 21, 22, *Fusarium.*)

Order 2. *Mucorini.* Spore-cases upon a filamentous receptacle, at first inclosed in a little peridium. (*Figs.* 25, 26, *Stilbum.*)

Order 3. *Macedines.* Spore-cases at first concealed by filaments. (*Figs.* 23, 24, *Aspergillus.*)

Order 4. *Hypodermi.* Spore-cases springing from under the cuticle of trees. *Figs.* 28, 29, *Exosporium.*)



Coniomycetous *Fungi.*

21, 22, *Fusarium tremelloides*, magnified; 23, a stem of grass covered with *Aspergillus penicillatus*; 24, the fungus itself, magnified; 25, *Stilbum tomentosum*, growing on a piece of wood; 26, a highly magnified representation of the same; 27, a spore case; 28, *Exosporium Tiliæ*, growing on a leaf; 29, a section of the same magnified; 30, three of the spore-cases, still more magnified.

The following arrangement of the *Fungi* is given in Lindley's 'Vegetable Kingdom':—

Spores generally quaternate, on distinct Sporophores. Hymenium naked.	*Hymenomycetes*, or *Agaricaceæ*.
Spores generally quaternate, on distinct Sphorophores. Hymenium inclosed in a Peridium. .	*Gasteromycetes*, or *Lycoperdaceæ*.
Spores single, often septate, on more or less distinct Sporophores. Flocci of the fruit obsolete, or mere poduncles.	*Coniomycetes*, or *Uredinaceæ*.
Spores naked, often septate. Thallus floccose.	*Hyphomycetes*, or *Bothylaceæ*.

Sporidia contained (generally eight together) in Asci. } *Ascomycetes*, or *Helvellaceæ*.

Spores surrounded by a vesicular veil or Sporangium. Thallus floccose. } *Physomycetes*, or *Mucoraceæ*.

(Fries, *Systema Mycologicum*; Greville, *Cryptogamic Flora*; *Neues System der Pilze*; Corda, *Icones*; Endlicher, *Genera Plantarum*; Hooker, *British Flora*; Sowerby, *Fungi*; Bulliard, *Figures of Fungi*; Lindley, *Vegetable Kingdom*; Berkeley, *Papers in Annals of Natural History*.)

FUNGIA. [MADREPHYLLIÆA.]

FURNARIUS. [CERTHIADÆ.]

FURZE. [ULEX.]

FUSTIC. This name appears to be derived from Fustet, the French name of a yellow dye-wood, the produce of Venetian sumach. A wood similar in colour and uses, but larger in size, having been subsequently imported from the New World, had the same name applied to it with the addition of Old, while the other, being smaller, is called Young Fustic; but these, so far from being the produce of the same tree at different ages, do not even belong to the same genus.

Young Fustic, or as it is sometimes called Zante Fustic, is the produce of *Rhus Cotinus* (*Anacardiaceæ*), a native of Italy, the south of France, and of Greece; much of it is exported from Patras in the Morea; and it also extends into Asia. It is supposed to be the *Cotinus* of Pliny, being still called Scotino near Valcimara, in the Apennines, where it is cultivated on account of its uses in tanning. The root and the wood of this shrub are both imported, deprived of their bark, and employed for dyeing a yellow colour approaching to orange, upon wool or cottons, prepared either with alum or the nitromuriate of tin with the addition of tartar. The colour is a beautiful bright yellow, and permanent when proper mordants are employed. Only small quantities of this kind of Fustic are imported.

Dr. Sibthorp was of opinion that *Rhamnus infectoria*, or *R. oleoides*, of which the berries are called French and Persian Berries, yielded the Fustic of commerce, and informs us that its yellow wood is called by the Greeks 'chrysoxylon.' He also thought that it was the *Lycium* of Dioscorides, but this has been shown by Dr. Royle to be a species of *Berberis*, of which genus all the species have yellow wood.

Old Fustic, the 'Bois Jaune' of the French, is on the contrary the produce of a large tree, *Morus tinctoria*, the Dyer's Mulberry, of the natural family of *Urticaceæ*, a native of Tropical America and the West India Islands. The tree attains a height of 60 feet; the wood is yellow-coloured, hard, and strong, but easily splintered, and is imported in the form of large logs or blocks. The yellow colour which it affords with an aluminous base, though durable, is not very bright. M. Chaptal discovered that glue, by precipitating its tannin, enabled its decoctions to die yellow almost as bright as those of weld and quercitron bark. The Fustic from Cuba is preferred, and fetches the highest price, varying from 8*l.* to 9*l.* 10*s.*, while that from Jamaica or Columbia varies from 5*l.* 10*s.* to 6*l.* 10*s.* per ton. The tree is figured by Sloane, and noticed by Marcgrave and Piso. Browne describes it as a native of Jamaica, and deserving the attention of planters, as it is only propagated by birds, who are fond of its sweet roundish fruit.

The several countries from which Fustic was imported, and the respective quantities received from each, were in 1836—

	Tons.
Italy and the Italian Islands	4
Ionian Islands	72
Morea and Greek Islands	18
British North American colonies	103
British West Indies	2053
United States of America	226
Mexico	172
Columbia	1913
Brazil	356
Total	4917

In 1850 the quantity imported into Liverpool was 9808 tons, of this 1771 tons were re-exported.

(Simmonds, *The Commercial Products of the Vegetable Kingdom*.)

FUSUS. [SIPHONOSTOMATA.]

G

GAD-FLY. [BOTS; ŒSTRIDÆ.]

GADIDÆ, a family of Fishes, generally arranged as the first of the sub-brachiate division of the *Malacopterygii*. This family embraces the whole of the species of the Linnæan genus *Gadus*. They are easily known by the position of the ventral fins under the throat, and the pointed character of these fins. The body is rather long, a little compressed, and covered with small soft scales. The head is well-proportioned and naked. All their fins are soft. The jaws and front of the vomer have unequal pointed teeth of middle or small size, and disposed in several rows like a card or rasp. The gill-covers are large, and they have seven rays. Most of the species have the dorsal fin contained in two or three bundles; they have also fins behind the vent, and a distinct caudal fin. The stomach is large, and the intestine long. The air-bladder is large and strong, and in some cases notched on the margins.

The greater number of the species of *Gadidæ* live in the cold or temperate seas, and furnish the greater portion of the fish obtained in the fisheries of Europe and America. The flesh of most of the species is white, easily separable into flakes, is agreeable to the taste, and easy of digestion. They are probably more useful to man than any other family of fishes. Their reproductive powers are very great, and the numbers in which they exist in some parts of the ocean is perfectly incalculable.

A detailed account of these fish is given under their generic names. The following are the British species of this genus as given in the 'British Museum Catalogue':—

I. *Morrhua*. [MORRHUA.]

1. *Morrhua Callarias*, Common Cod.
2. *M. Æglefinus*, Haddock.
3. *M. lusca*, Bib and Pout.
4. *M. minuta*, Poor.

II. *Merlangus*. [MERLANGUS.]

1. *Merlangus vulgaris*, Whiting.
2. *M. albus*, Couch's Whiting.
3. *M. carbonarius*, Coal-Fish.
4. *M. Pollachius*, Pollack.

III. *Merlucius*. [MERLUCIUS.]

1. *Merlucius vulgaris*, Common Hake.

IV. *Lota*. [LOTA.]

1. *Lota molva*, Ling.
2. *L. vulgaris*, Burbot.

V. *Motella*. [MOTELLA.]

1. *Motella tricirrata*, Three-Bearded Rock-Ling.
2. *M. cimbria*, Four-Bearded Rock-Ling.
3. *M. mustela*, Five-Bearded Rock-Ling.
4. *M. argenteola*, Silvery Gade.

VI. *Brosmius*. [BROSMIUS.]

1. *Brosmius Brosme*, Torsk.

VII. *Phycis*. [PHYCIS.]

1. *Phycis bifurcus*, Forked Hake.

VIII. *Raniceps*. [RANICEPS.]

1. *Raniceps fuscus*, Trifurcated Hake.

The genus *Brotula* is found in the West Indian Seas, and *Lepidoleprus* in the Mediterranean and Atlantic Seas.

GADOLINITE, a Mineral, containing Yttrium. [PYROCHLORE; YTTRIUM.]

GADWALL. [DUCKS.]

GA'GEA, a genus of Plants belonging to the natural order *Liliaceæ*, and the tribe *Asphodeleæ*. It has a perianth of six patent leaves, the stamen adhering to the base of the perianth; the anthers erect, attached by their bases. The flowers of the species are corymbose or umbellate.

G. lutea (the *Ornithogalum luteum* of many botanists) has the radical leaves usually solitary, linear-lanceolate, flat; the bracts two, opposite; the peduncles umbellate, simple, glabrous; the segments of the perianth oblong, obtuse; the bulb ovate, solitary. The stem of this plant is about 6 inches high, and shorter than the leaves. Its flowers are yellow. It is a native of England and Scotland in woods, but is a rare plant. It is a native of Europe, and is found on the Alps in Switzerland. Koch describes 10 species of this genus as natives of Germany and Switzerland.

(Babington, *Manual of British Botany*; Koch, *Flora Germanica*.)

GAHNITE, a Mineral, also called *Automolite*. It is a variety of *Spinel*, containing 34·8 per cent. of oxide of zinc. It has a dark green or black colour. Its hardness is 7·5 to 8, and specific gravity 4·26. It is infusible alone, and nearly so with borax. With soda it forms at first a dark scoria, and when fused again with more soda, a ring of oxide of zinc on the charcoal.

GALAGO. [LEMURIDÆ.]

GALANGA, or GALANGAL, is usually supposed to have been introduced by the Arabs, but it was previously mentioned by Ætius. The Arabs call it Khelingan, which appears to be derived from the Hindoo Koolinjan, or Sanscrit Koolunjuna, indicating the country whence they derived the root, as well as the people from whom they obtained their information respecting its uses. The plant which yielded this root was long unknown, and it was supposed to be that of a Pepper, of an Iris, of *Acorus Calamus*, or to be the *Acorus* of the ancients. *Kæmpferia Galanga* was so called from its aromatic roots being supposed to be the true *Galangal*. The tubers of *Cyperus longus* were sometimes substituted, and called English Galangal. Two kinds, the large and the small galangal, are described; these are usually considered to be derived from the same plant at different stages of its growth, but Dr. Ainslie, in his 'Materia Indica,' insists upon the greater value of the lesser, as this is warmer and more fragrant, and therefore highly prized in India. It is a native of China, and the plant producing it is unknown. Dr. Ainslie does not prove that it is the *Galanga minor* of Europe.

The Greater Galangal has long been known to be the produce of a Scitamineous plant, the *Galanga major* of Rumphius ('Herb. Amb.' 5. t. 63), which is the *Alpinia Galanga* of Wildenow, and a native of China and the Malayan Archipelago. It is fully described by Dr. Roxburgh, in his 'Flora Indica,' vol. i. p. 28, ed. Wall. The roots, perennial and tuberous, like those of the ginger, were ascertained by Sir Joseph Banks and Dr. Comb to be identical with the *Galanga major* of the shops. This is cylindrical, often forked, thick as the thumb, reddish-brown externally, marked with whitish circular rings, internally lighter coloured, of an agreeable aromatic smell, and a hot spicy taste, like a mixture of pepper and ginger, with some bitterness. The stem is perennial, or at least more durable than those of herbaceous plants. When in flower, about 6 or 7 feet in length; its lower half invested by leafless sheaths. The leaves are two-ranked, lanceolar, from 12 to 24 inches long, and from 4 to 6 inches broad. Panicle terminal, crowned with numerous branches, each supporting from two to five pale greenish-white and somewhat fragrant flowers in April and May in Calcutta, where the seeds ripen, though rarely, in November.

Several species of this genus have roots with somewhat similar properties. Thus *Alpinia alba* and *A. Chinensis* are much used by the Malays and Chinese; the former has hence been called *Galanga alba* of Kœnig; and the latter has an aromatic root with an acrid burning flavour. The fragrant root of *Alpinia nutans* is sometimes brought to England, according to Dr. Roxburgh, for *Galanga major*. Its leaves, when bruised, have a strong smell of cardamoms, and the *Cardamomum* plant is frequently placed in this genus, but has been described under ELETTARIA.

GALANTHUS, a genus of Plants belonging to the natural order *Amaryllidaceæ*, consisting of the Snowdrop and another species. The former plant is a native of subalpine woods in various parts of Europe; the second, which is the *G. plicatus* of botanists, inhabits the Asiatic provinces of the Russian and Turkish empires.

Galanthus is thus characterised:—Perianth 6-parted, 3 outer segments spreading, 3 inner shorter, erect, emarginate. Stamens equal, subulate.

G. nivalis, the Snowdrop, has white drooping flowers with the inner segments greenish. The scape 1-flowered, the leaves 2, keeled, broadly linear, glaucous. It grows in thickets, and blossoms in February and March.

GALATHEA. [GALATHEIDÆ.]

GALATHEIDÆ, a group of Crustaceans corresponding with the genus *Galathea* of Fabricius, and establishing, in the opinion of M. Milne-Edwards, a passage between the Anomurous and Macrurous Crustaceans, being more particularly approximated to the *Porcellanæ*. [PORCELLANIDÆ.] Dr. Leach divided the genus established by Fabricius into four: namely, the true *Galatheæ*, *Munidea*, *Grimothea*, and *Æglea*. M. Milne-Edwards thinks that three of these genera should be preserved, but agrees with M. Desmarest in coming to the conclusion that the genus *Munidea* has not sufficient characteristics to admit of its adoption in a natural classification. With regard to *Æglea*, M. Milne-Edwards considers it as approximating more to the *Porcellanæ* than to the *Galatheæ*, and as occupying a place in the section of the *Anomura*.

The *Galatheidæ*, then, according to the revision of M. Milne-Edwards, are thus distinguished:—Carapace depressed and wide, but still longer than its width, terminating anteriorly by a rostrum more or less projecting, which covers the place of the ocular peduncles, and presents on its upper surface many furrows or wrinkles, among which one deeper than the rest defines the posterior part of the stomachic region. Antennæ inserted on the same transversal line; internal antennæ but little elongated, placed under the ocular peduncles, and terminated by two small, multiarticulate, very short filaments; external antennæ with no trace of palpiform appendages at their base, but with a cylindrical peduncle and a long and slender terminal filament. External jaw-feet (pates-mâchoires) always pediform, but varying a little in their conformation. Sternal plate (plastron sternal) widening a good deal posteriorly, and the last thoracic ring ordinarily distinct. Anterior feet large, and terminated by a well-formed claw; those of the three following pairs of limbs rather stout, and terminated by a conical tarsus; fifth pair very slender, and folded above the others in the branchial cavity; these last do not assist the locomotion, and are terminated by a rudimentary hand. Abdomen nearly as wide as the thorax, and longer, vaulted above and armed on each side with a row of four or five large teeth formed by the lateral angle of the superior arch of the different rings composing it, and terminated, as in the greater part of the Macrurous Crustaceans, with a large fan-shaped lamelliform fin. The number of abdominal false feet varies; in the male there are five pairs, the first two of which are slender and elongated, and the last three are terminated by an oval lamina ciliated on the edge; in the female, the first abdominal ring is without appendages, but the four following segments have each a pair of false feet composed of three joints placed end to end, and fringed with hairs for the attachment of the eggs.

Galathea.—The whole surface of the carapace covered with transverse furrows fringed with small brush-like hairs. Hepatic regions, in general, well distinguished from the branchial, and occupying with the stomachic region nearly half of the space of the carapace. Rostrum projecting and spiny; eyes large and directed downwards; no trace of an orbit. A spine above the insertion of the external antennæ, and two others on the anterior part of the stomachic region. Basilary joint of the internal antennæ cylindrical and armed at its anterior extremity with many strong spines; the two following joints slender and nearly as long as the first. Peduncle of the external antennæ composed of three small cylindrical joints, the last of which is much smaller than the others. External jaw-feet moderate, the two last joints neither foliaceous nor even enlarged. Anterior feet long and depressed. (Milne-Edwards.)

*

Species whose external jaw-feet present a row of teeth on the internal edge of their second joint.

a Third joint of the external jaw-feet shorter than the second.

G. strigosa (*G. spingera*, Leach; *Cancer strigosus*, Linn.). It has the rostrum triangular and armed with seven strong projecting spiniform teeth. Lateral edges of the carapace with strong spiniform teeth. Three long spines at the anterior extremity of the first joint

Galathea strigosa.

of the external antennæ; a great spine under the auditory tubercle, two smaller ones on the first joint of the external antennæ, and one on their second joint. External jaw-feet short, hardly overpassing the rostrum when they are extended, their third joint much shorter than the second, and armed beneath with two strong spines. Anterior feet long, depressed, and very spiny; the hand very large, edged with spines and ornamented above with small piliferous furrows resembling imbricated scales; claws short, large, and with a spoon-shaped termination. Feet of the second and third pair of the same length. Abdomen furrowed transversely, but without a spine; the seventh segment a little widened and rather narrower behind than before. Colour reddish, with some blue lines on the carapace. Length about five inches. It is found in the Mediterranean, and is not uncommon on the coasts of Great Britain. Mr. Couch says it is common on the whole of the south coast of Cornwall. It frequents pools between tide-marks where there are loose stones and sand.

β. Third joint of the external jaw-feet much longer than the second.

G. squamifera. It is found on the coasts of England and France.

**

Species whose external jaw-feet have no dentilation on the internal edge of their second joint.

G. Monodon. It inhabits the coasts of Chili.

G. nexa, a new species described by Dr. Embleton, is found on the English and Irish coasts.

Grimothea.—Differing but little from *Galathea*, and hardly sufficiently distinct for separation. General form of both essentially the same, but the basilary joint of their internal antennæ is claviform and hardly dentated at its extremity, and the external jaw-feet are very long, and have their three last joints enlarged and foliaceous. (Milne-Edwards).

M. Milne-Edwards observes that the crustacean figured by M. Guérin under the name of Grimothée Sociale ('Voyage of La Coquille:' Crust., pl. 3, fig. 1) differs from *G. gregaria* in the form of the caudal fin, the middle lamina of which is less than the lateral ones. M. Edwards proposes therefore to name it *Grimothea Duperreii*, in honour of the navigator whose voyage made the species known.

GALAXAURA. [PSEUDOZOARIA.]

GALBA. [ELATERIDÆ.]

GA'LBANUM. Though the drug known by this name is one of those which have been the longest known, the plant which yields it still remains undetermined, though it is stated by old writers to be a native of Syria. The Greek name Chálbane (χαλβάνη) is evidently the same as the Hebrew Chelbenah, by which the same substance is supposed to be alluded to in the book of Exodus. Arabian authors describe it under the name Barzud. The Persians call it Birzud, and give Birceja as its Hindoo synonym. That the same substance is intended, is evident from Khulyan and Metonyon, as stated by Dr. Royle ('Illustr. Himal. Bot.,' p. 23), being given as its Greek synonyms, which are evident corruptions of Chalbane and Metopion, the names of this substance in Dioscorides. The plant yielding this substance is called Kinneh and Nafeel by Arabian and Persian authors, by whom it is described as being jointed, thorny, and fragrant. Under the first name it is noticed in the original of Avicenna, but omitted in the Latin translation. D'Herbelot ('Bibl. Orient.') however states, that the plant yielding Galbanum is called Ghiarkust in Persia. These names are interesting only as showing that both the plant and gum-resin appear to have been familiarly known to both Arabians and Persians, and that therefore the former is probably a native of these countries, though usually stated to be only a native of Syria. But if so, it could hardly have escaped the notice of the numerous travellers who have visited that country.

One plant, often described as yielding this long-known gum-resin, is *Bubon Galbanum*, a native of the Cape of Good Hope, which Hermann describes as yielding spontaneously, by incision, a gummy, resinous juice, similar to Galbanum; but Mr. Don has observed that this plant possesses neither the smell nor the taste of Galbanum, but in these particulars agrees better with fennel; and its fruit has no resemblance whatever to that found in the gum. The fruit, commonly called seed, was early ascertained by Lobel to be that of an Umbelliferous Plant, broad and foliaceous, which he picked out of *Galbanum*, and, having sowed, obtained a plant, which he has figured under the name of *Ferula galbanifera*. This has been lost or become confounded with other species; but it is probable that it was the plant yielding Galbanum, as Mr. Don has recently obtained fruit in like manner, and something similar, which he has determined to be allied to the genus *Siler*, but differing in the absence of dorsal resiniferous canals, and the commissure being furnished with only two. The carpels are about 9 lines in length and 4 lines broad, flat internally and somewhat converse externally. As the plant is still unknown, it is well worthy the investigation of travellers in the East, who might otherwise suppose, from the name, assigned from the seed, having been adopted in the 'London Pharmacopœia,' that the plant was as well known as its product.

Three sorts of Galbanum are distinguished:—1. Galbanum in grains or tears; 2. Galbanum in masses; and 3. Persian Galbanum. The two former come from Africa, especially Æthiopia; the third sort from Persia. Galbanum in tears is most likely the spontaneous exudation from the plant; and that in masses, obtained by incisions. The first sort occurs in irregular generally oblong grains, mostly distinct, but sometimes agglutinated together, about the size of a lentil or small pea, of a colour verging from whitish into yellowish-brown, more or less diaphanous, opaque, or shining with a resinous lustre. The odour is strongly balsamic, and disagreeable. The taste is resinous, sharp, bitter, and disagreeable. Specific gravity, 1·212.

It is partially soluble in alcohol, and the solution, as well as the strong white smoke which is evolved when Galbanum is melted in a platinum spoon, reddens litmus paper. It consists chiefly of resin, gum, volatile oil, and a trace of malic acid.

Galbanum in masses consists of irregular pieces of a yellowish or dark brown colour; the odour is stronger than that of the preceding kind, which, in its general characters, it much resembles, except that it can be powdered only during the low temperature of winter. Geiger says that when this variety is pure, it is not to be reckoned inferior to the former. Persian Galbanum, being very soft and tenacious, is sent in skins or chests. It often contains many fragments of plants.

Galbanum, like other umbelliferous gum-resins, is anti-spasmodic, expectorant, and externally rubefacient. It is inferior in power to assafœtida, but usually associated with it in pills and plasters.

GALBULA. [HALCYONIDÆ.]

GALE, SWEET. [MYRICA.]

GALENA. [LEAD.]

GALEOLARIA. [ACALEPHÆ.]

GALEOPITHECUS, a genus of *Mammalia*, having relations to the *Lemuridæ* and *Cheiroptera*. It is often formed into a family, and is then called *Pleuroptera* or *Galeopithecidæ*. They are commonly known by the name of Flying Lemurs, and are sometimes called Flying Cats and Flying Foxes. They are generally arranged under the order Carnassiers, and some authors place them in the division *Cheiroptera*; but they differ from the Bats inasmuch as the toes of their anterior extremities, which are all furnished with sharp claws, are not more elongated than those of the hind feet, so that the membrane which occupies the interval between the extremities to the sides of the tail can hardly operate in executing more than the functions of a parachute. The dental formula is as follows:—

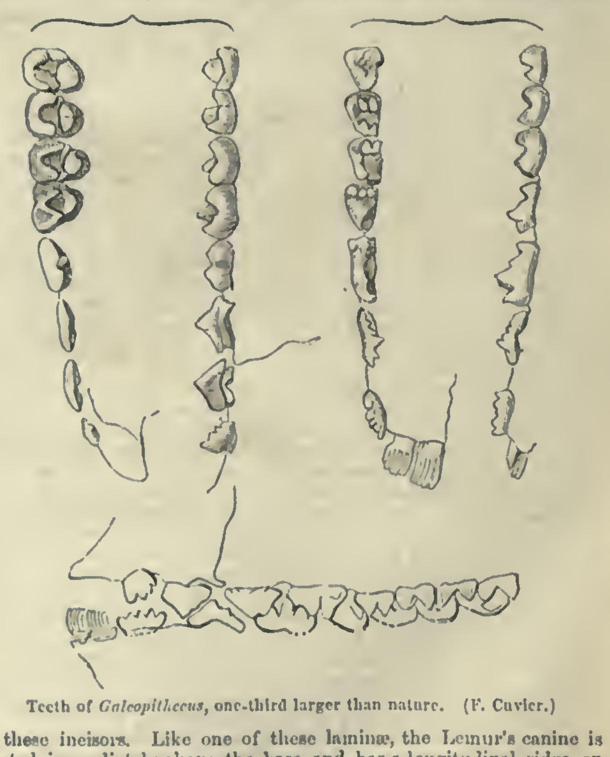
$$\text{Incisors, } \frac{4}{6}\text{; Canines, } \frac{0-0}{0-0}\text{; Molars, } \frac{6-6}{6-6} = 34.$$

This is the formula given by M. Lesson; but Cuvier, in his 'Règne Animal,' states that the canines are dentilated and short like the molars. He states that the two upper incisors are also dentilated and much separated from each other; and that the six lower ones are split into narrow strips like combs, a structure peculiar to this genus.

F. Cuvier's formula is similar to that of M. Lesson, and was probably copied by the latter. F. Cuvier describes the 12 molars in both jaws as consisting of 4 false molars and 8 molars. He tells us that in the upper jaw, the intermaxillary bone, though very extensive, has no teeth in its anterior part; in the posterior part there are two on each side. The descending line in the upper part of the lower figure marks the extent of the intermaxillary bone. The dentition, as it appears to Mr. Waterhouse, is as follows:—

$$\text{Incisors, } \frac{2-2}{4}\text{; Canines, } \frac{0-0}{1-1}\text{; False Molars, } \frac{2-2}{2-2}\text{; True Molars } \frac{4-4}{4-4} = 34.$$

The same author observes that the six foremost teeth in the lower jaw of the Lemur (four only of which are, in his opinion, incisors; for he agrees with Geoffroy in considering the remaining two as canines) together bear a remarkable resemblance to a single incisor of *Galeopithecus*. He compares the two canines to the outer laminæ of one



Teeth of *Galeopithecus*, one-third larger than nature. (F. Cuvier.)

of these incisors. Like one of these laminæ, the Lemur's canine is dilated immediately above the base, and has a longitudinal ridge on the upper side; whilst the incisors, like the intermediate laminæ, are grooved on the outer side near the apex. In their almost horizontal direction there is also a resemblance. In the number of teeth the *Galeopitheci* agree with the Lemurs, excepting that in the former the upper canines are wanting. In both these groups of animals the incisors of the lower jaw are, he observes, opposed to a toothless portion of the intermaxillaries. ('Zool. Trans.,' vol. ii. part 4.)

Cuvier and others state that the *Galeopitheci* live on trees in the islands of the Indian Archipelago, and there pursue insects, and perhaps birds, as their prey: judging from the detrition of the teeth with age, he thinks that they must also feed on fruits. They have a very large cæcum. In their teeth they present many analogies to the *Lemuridæ*.

Dr. Gray makes the *Galeopithecidæ* the fourth family of the (quadrupedoid) *Primates*, and places it between the *Lemuridæ* and *Vespertilionidæ*. ('Outline,' &c., in 'Ann. of Philosophy,' 1825.)

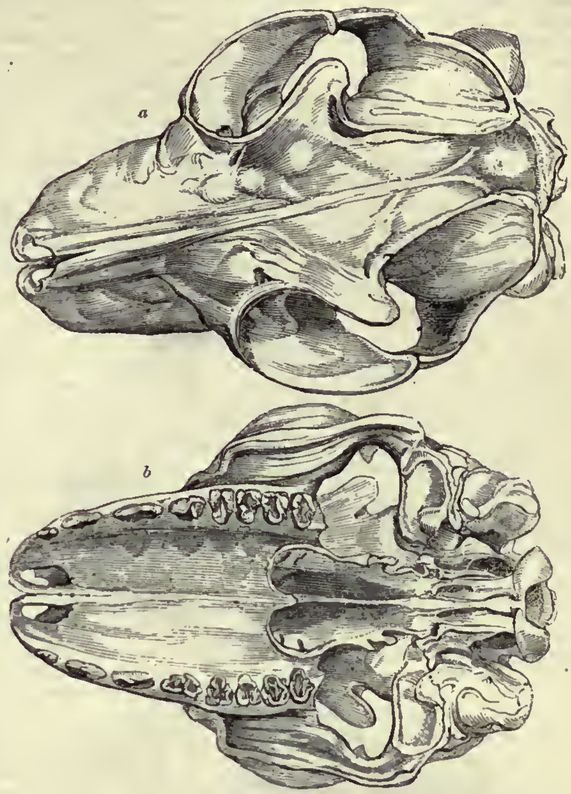
Speaking of the *Galeopithecus* of Pallas, Mr. Swainson observes:—"To give its most striking character in a few words, it is a lemur, with the limbs connected with a bat-like membrane, or, in other words, surrounded by a thin skin which they support, as the framework of an umbrella supports its covering. By this singular structure the animal is supported in the air; yet without the power, like the bats, of sustaining a continued flight. Linnæus places this remarkable genus with the lemurs, while every one must perceive its intimate affinity to the bats; like them, also, these bat-lemurs are nocturnal and insectivorous. The mammæ are pectoral; and they sleep suspended by their hind legs with their heads downward. M. Geoffroy St. Hilaire therefore justly considers them as the form by which the lemurs and bats are connected; while their greater resemblance to the former induces us to consider *Galeopithecus* as one of the aberrant types of the *Lemuridæ*," among which Mr. Swainson arranges the genus, in the third part of his volume, between *Aötes* and *Cheirogaleus*. ('Natural History and Classification of Quadrupeds,' 1835.)

Three species have been recorded:—1. *Galeopithecus rufus*, Geoff., Audubon (*Lemur volans*, Linn.); 2. *Galeopithecus variegatus*, Cuv., Geoff.; 3. *Galeopithecus Ternatensis*, Geoff.: but the general opinion seems to have been that one only, the *Lemur volans* of Linnæus, had been satisfactorily made out. In October, 1838, some specimens of Flying Lemurs were upon the table at a meeting of the Zoological Society of London; and in reference to them Mr. Waterhouse pointed out certain characters which appeared to him to indicate the existence of two species in those specimens.

He remarked that in systematic works three species of the genus *Galeopithecus* are described, founded upon differences of size and colour. As regards the latter character, he had never seen two specimens which precisely agreed; and with respect to size, the dimensions given of two out of the three species are, he observed, evidently taken from extremely young animals. Mr. Waterhouse then proceeded to distinguish the two species on the table, and proposed for them the specific names of *Temminckii* and *Philippinensis*.

Galeopithecus Temminckii.

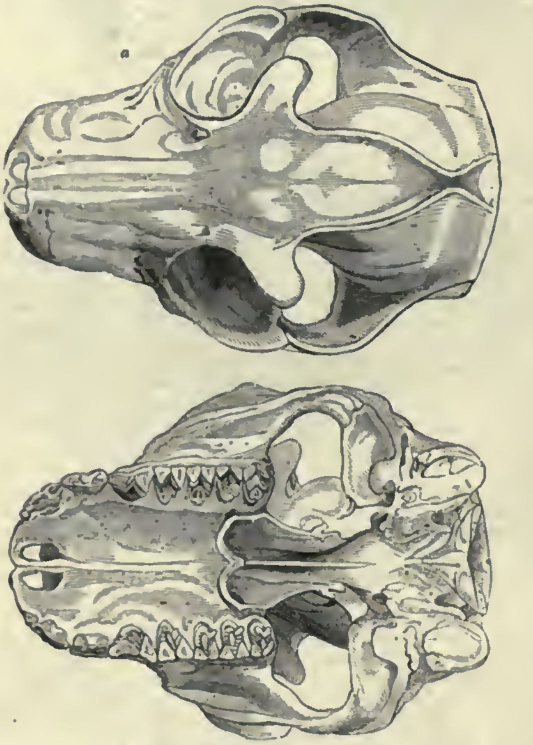
The first and larger species measured about two feet in total length, and its skull was 2 inches 11½ lines in length. The anterior incisor of the upper jaw is broad, and divided by two notches into three distinct lobes; the next incisor on each side has its anterior and posterior margins notched; and the first molar (or the tooth which occupies the situation of the canine) has its posterior edge distinctly notched. This tooth is separated by a narrow space, anteriorly and posteriorly, from the second incisor in front and the second molar behind; the temporal ridges converge towards the occiput, near which however, he observed, they are separated usually by a space of about four lines. This is probably the *Galeopithecus volans* of authors; but the identity cannot be said to be certain.



Skull of *Galeopithecus Temminckii.*
a, seen from above; *b*, seen from below. (Waterhouse, 'Zool. Trans.')

Lower Jaw and Teeth of *Galeopithecus Temminckii.*
1, under side of the Lower Jaw; 2, side view of the same; 3, the three foremost teeth on either side of the Upper Jaw; 4, 5, outer and inner incisors of the Lower Jaw. (Waterhouse, 'Zool. Trans.')

The second species, *G. Philippinensis*, was described by Mr. Waterhouse as being usually about 20 inches in length, and its skull as measuring 2 inches 7 lines in length. He observed that this species may be distinguished from *G. Temminckii* by the proportionately larger ears and the greater length of the hands. The skull too he described as narrower in proportion to its length, the muzzle as broader and more obtuse, and the orbit as smaller. The temporal ridges, he observed, generally meet near the occiput, or are separated by a very narrow space. The anterior incisor of the upper jaw is narrow, and has but one notch; the next incisor on each side is considerably larger, longer, and stronger than in *G. Temminckii*, and differs moreover in having its edges even: the same remark applies to the first false molar. In this species the incisors and molars form a continuous series, each tooth being in contact with that which precedes and that which is behind it. But Mr. Waterhouse concluded by observing that the most important difference perhaps which exists between the two species in question consists in the much larger size of the molar teeth in the smaller skull, the five posterior molars occupying a space of ten lines in length, whereas in *G. Temminckii*, a much larger animal, the same teeth only occupy nine lines. Several minor points of distinction existed besides those here mentioned. ('Zool. Proc.,' 1839; and see further 'Zool. Trans.,' vol. ii. p. 335.)



Skull of *Galeopithecus Philippinensis*.
a, upper side; *b*, under side.

Lower Jaw and Teeth of *Galeopithecus Philippinensis*.
1, under side of the Lower Jaw; 2, side view of the same; 3, the three foremost teeth, Upper Jaw; 4, 5, outer and inner incisors of Lower Jaw. (Waterhouse, 'Zool. Trans.')

Mr. Waterhouse remarks that the first two of the three foremost teeth of the upper jaw, commencing with the smallest tooth, are situated in the intermaxillary bone, and are therefore incisors. He adds that it is worthy of observation, that the posterior of these two teeth (on each side) has a double fang.

GALEOPSIS (from γαλῆ, a weasel, and ὄψις, sight, aspect, the mouth of the corolla gaping like that of a weasel), a genus of Plants belonging to the natural order *Labiatæ* or *Lamiaceæ*. It has the anthers approaching in pairs, opposite cells bursting by two valves transversely; the upper lip of the corolla arched, and the lower lip 3-lobed, unequal, with two teeth on its upper side; a tubular 5-toothed calyx, with equal teeth, or the two upper ones longest. The nuts are rounded at the end. The species of this genus are annual divaricately branched erect herbs, and rarely decumbent at the base. The flowers are red or cream-coloured, or varied with both these colours. This genus may be easily recognised by the peculiar formation of its anthers, which differs from any other of the *Labiatæ*.

G. ochroleuca, the Cream-coloured Hemp-Nettle, has a softly pubescent stem with deflexed hairs, not thickened below the joints, oblong or oblong-lanceolate leaves, clothed with soft villi on both surfaces. The calyx is shaggy and glandular, and the upper lip of the corolla deeply cut. This species is found in the sandy corn-fields of middle Europe, and also in England and Wales. The flowers are of a pale-yellow or cream-colour, and bloom during the months of July and August.

G. ladanum, the Red Hemp-Nettle, is distinguished by having the upper lip of the corolla slightly notched. It is a native throughout Europe, and is found plentifully in the sandy corn-fields of Great Britain. The flowers are of a purple colour, variegated with crimson and white. A variety of this species, with flowers half the usual size, is the *G. intermedia* of Reichenbach, and the *G. parviflora* of Lambert.

G. tetrahit, the Common Hemp-Nettle, has a hispid stem, thickened below the joints, with oblong, ovate, acuminate, serrate leaves. The calyx has tubular teeth, and a tube nearly equal. The tube of the corolla is as long as the calyx, and has an ovate upper lip. It is of a purple colour, and is a native of cultivated ground throughout Europe and Middle Asia, and is plentiful in Great Britain.

G. versicolor has the tube of the corolla much longer than the calyx. The flowers are very large, yellow, and have a broad purple spot on the lower lip. It is not easily distinguished by description from *G. tetrahit*, of which it is regarded as a variety by many botanists.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*.)

GALERITES. [CONULUS; ECHINIDÆ.]

GALEUS. [SQUALIDÆ.]

GALIA'CEÆ, *Stellates*, a natural order of Exogenous Plants called *Stellatæ* by Linnæus, and merged in *Cinchonaceæ* by the school of Jussieu. It consists of herbaceous usually square-stemmed plants, with a scabrous surface, verticillate leaves, and monopetalous flowers, with an inferior didymous fruit inclosing a couple of seeds containing an embryo lying in a great quantity of horny albumen. Some yield a dyeing substance in their roots, as the various species of Madder, but the greater part are useless weeds. One of our common British species of *Galium*, namely, *G. verum*, is astringent, and was formerly used by farmers to curdle milk.

1, *Sherardia arvensis*; 2, a perfect flower, magnified; 3, a vertical section of the same, without the corolla; 4, a transverse section of a ripe fruit.

The species are natives of the northern parts of the northern hemisphere, where they are very common weeds. The order is related to *Cinchonaceæ*, *Cornaceæ*, and *Apiaceæ*. There are 8 genera and 320 species. [GALIUM; MADDER; ASPERULA.]

GALIPE'A, a genus of Plants belonging to the natural order *Rutaceæ*, inhabiting the warmer parts of South America. Their leaves are often simple, occasionally 3-4-5-leafleted, not divided at the edge, covered with pellucid or grandular dots. The flowers are small, white or pink, often fragrant, in axillary, extra-axillary or terminal racemes, corymbs, or panicles.

G. cusparia is a tree from 60 to 80 feet high, evergreen, with an ash-coloured bark and a pale yellow box-like wood. The leaves are alternate, long-stalked; the leaflets 3, sessile, unequal, ovate, lanceolate, acute, smooth, entire, bright-green, gratefully fragrant, with scattered glandular dots. The flowers are in axillary and terminal racemes, on a peduncle as long as the petioles. The calyx and corolla are white, with fascicles of hairs seated on glandular bodies on the outside. The anthers have two short appendages. This species is said by Humboldt to produce Angostura Bark, but this is denied by Dr. Hancock, who assigns it to the following species.

G. officinalis is found in the higher lands of the missions of Carowy. It is well known in the southern and back missions of the Orinoco. The bark is smooth. The leaves alternate, 3-foliate; the petiole about the length of the leaflets, slightly channelled, the leaflets ovate, acute at the base, acuminate at the apex, smooth, glossy, bright-green, smelling when bruised and fresh like tobacco; from 6 to 10 inches long, 2 to 4 inches broad; some of the leaflets are marked with small whitish round spots. The panicles are cylindrical, contracted, stalked, longer than the leaves, with the branches about 3-flowered. The calyx is campanulate, 5-toothed, hairy. The corolla white, somewhat curved before expansion; nearly an inch long, downy on both sides; of the 5 petals two larger than the others. There are 5 sterile stamens, tipped with a pellucid watery gland. The fertile stamens 2 in number, 5 carpels or fewer, becoming villous as they mature; 2-seeded, with a strong elastic separable 2-valved endocarp. According to Dr. Hancock, this, which he found to yield the true Angostura, or Carowy Bark, is essentially different from the *Cusparia febrifuga* of Humboldt. An excellent account of that bark is given by Dr. Hancock in the 'Transactions of the Medico-Botanical Society.' "I am fully convinced," says he, "from ample experience of the virtues of this bark, that it is one of the most valuable febrifuges we possess, being adapted to the worst and most malignant bilious fevers, while the fevers in which Cinchona is administered are chiefly simple intermittents, for the most part unattended with danger. The natives use the bruised bark as a means of intoxicating fishes, which affords a very singular coincidence with what is mentioned by Dr. Saunders, by the same use being made of Cinchona Bark by the Peruvian Indians. Malambo Bark is supposed to be furnished by some plant allied to *Galipea*.

GA'LIUM (from γάλα, milk), a genus of Plants belonging to the natural order *Galiaceæ* or *Rubiaceæ*. The corolla is rotate, 4-parted; the fruit dry, not crowned with the calyx, and composed of two indehiscent 1-seeded mericarps. The species are branched herbs with variable inflorescence.

G. cruciatum, Crosswort, has elliptic oblong hairy leaves, four in a whorl; the flower-stalks lateral, corymbose, bracteated; terminal fertile flowers, mostly stamniferous; the fruit-stalks deflexed, and the fruit smooth. It is a native of Europe, and is commonly found in Great Britain.

G. mollugo, Great Hedge-Bedstraw, or Wild Madder, has about 8 leaves in a whorl, they are lanceolate-obovate or obovate-oblong; the margins rough with prickles pointing forwards; the branches of the panicle many-flowered, the lower ones spreading horizontally; the fruit glabrous. This species is a native almost throughout Europe and the Caucasus, and is found in Britain. The flowers are white, and sometimes yellowish. The roots are creeping, and yield a red dye like the true Madder, but of a brighter colour; they also have the property of colouring the bones of animals red that feed upon them. This plant has been extolled by M. Jourdan, the director of the hospital at Tain, in Dauphiny, as an effectual cure for epilepsy. It is however to be feared that the cases he details, which are certainly very marvellous, will not justify his reliance on this remedy.

G. tinctorium, the Dyer's Bedstraw, has smooth decumbent stems; linear-obtuse leaves, scabrous on the margin and keels; elongated axillary terminal and many-flowered peduncles. The corolla has 4 obtuse lobes, and the fruit is smooth and glabrous. This species is a native of North America, in low marshy places, especially in Canada and Newfoundland; it is also found in the Straits of De Fuca. It is very nearly allied to *G. trifidum*, but is distinguished by the stems being smooth and the flowers always 4-parted.

G. palustre, a native of Great Britain, nearly resembles *G. tinctorium* when the leaves are more numerous than usual. It is said that from the roots of this plant the Indians extract the red dye with which they colour their feathers and the ornaments of their dress.

G. septentrionale, the Northern Bedstraw, has erect tetragonal smooth stems; oblong lanceolate leaves, 4 in a whorl. The fruit is beset with hooked bristles; the flowers are numerous and of a milk-white colour. The Cree women use the root of this plant to dye red. It is a native of North America, about the lakes of Canada and the United States.

G. verum, Ladies' Bedstraw, or Cheese-Rennet, is distinguished by having its leaves about 8 in a whorl, linear-setaceous with revolute margins, channelled above, downy beneath. The flowers in numerous small dense panicles of a golden-yellow colour. On loose sandy soils the flowers are sometimes solitary and the stems much more branched, but agreeing in other respects with this species. It is a native of Europe and Siberia, in meadows, woods, and among bushes, and is found in Britain very commonly in dry soils. The stalks and flowers of this plant have been used in the cheese counties for the purpose of curdling milk, and also for colouring it. Mathiolus says it produces an agreeable flavour, and makes the cheese "eat sweeter." The French formerly used to prescribe the flowers in hysteria and epilepsy. The roots afford a rich red dye, superior in colour to madder. It was grown at one time as a substitute for the true Madder, *Rubia Tinctorum*, but the roots are too small to render its culture profitable. This plant seems to be the γάλιον of Dioscorides.

G. aparine, the common Goose-Grass, or Cleavers, has from 6 to 8 leaves in a whorl; they are linear-lanceolate, with marginal prickles pointing backwards; axillary 3-flowered peduncles; reflexed granulated fruit. It is a native throughout the whole of Europe, north of Asia, and North America, in hedges, fields, and most cultivated places; it is plentiful in Great Britain. This plant, according to Burnett, was fancifully called by the Greeks Philanthropos, as they attributed the readiness with which it cleaves to our habiliments to a love of the human species. A mechanical cause will however fully account for this tendency. It is thus it has acquired the names of Cleavers, Catch-Weed, &c., and from being a favourite food or medicine of geese that of Goose-Grass. Dioscorides relates that this plant was used by the shepherds of his time as a sieve to strain milk, and Linnæus tells us it is still made use of in Sweden for the same purpose. It is the ἀπαρίνη of Theophrastus. The expressed juice of this herb taken in doses of four ounces or a quarter of a pint night and morning, during several weeks, is said to be a very beneficial remedy in cutaneous disorders, and is believed by the country people to be a purifier of the blood and an antiscorbutic. The seeds have a corneous albumen, and when roasted have been used instead of coffee. We are not aware that they have been analysed, but it is not improbable that they contain a principle similar to caffein, and if this be the case they would form a valuable substitute for coffee. The roots of this species, like most of the genus, afford a rich red dye, and birds that feed on them have their bones tinged with the colour. The roots of *G. tuberosum* are farinaceous, and in China are cultivated as a dietetic vegetable. Loureiro says that when boiled they are both wholesome and nutritious. Don enumerates 164 species of *Galium*, which are distributed in every quarter of the world. The common name Bedstraw given to all the species is from the verb to 'strew,' anciently written 'straw.' Before the introduction of modern luxuries beds were made by strewing with various herbs, and doubtless this was one used for that purpose, and has thence acquired its common name. These plants are very easily cultivated and propagated; they will grow in any common soil, care being paid to the situations in which they are placed, which should as much resemble their natural positions as possible; those brought from marshes and bogs should have a moist soil, and the natives of warmer climates should be protected during the winter. None of them however are worth cultivation unless in botanical gardens.

(Fraas, *Synopsis Plant. Floræ Classicæ*; Don, *Dichlamydeous Plants*; Burnett, *Outlines of Botany*; Babington, *Manual of British Botany*.)

GALL. [BILE.]

GALL-BLADDER. [LIVER.]

GALLI'COLÆ, a family of Hymenopterous Insects of the section *Pupivora*. Distinguishing characters:—Posterior wings having but one nervure; anterior wings with two branchial cells, a radial cell of a triangular form; two or three cubital cells, of which the second (where there are three) is very small, and third large, and bounded by the apical margin of the wing; antennæ of equal thickness from the base to the apex (or with the latter portion slightly thickened), and consisting of from 13 to 15 joints. The males with one joint more to the antennæ than the females. Palpi long; the maxillary usually 4-jointed, and the labial 3-jointed. Ovipositor lodged in a groove on the under side of the body.

Latreille enumerates but three genera belonging to this family. Those which have the antennæ filiform, the abdomen much compressed, the radial cell of the wing long and narrow, the two brachials very distinct, and the first two cubitals small, constitute the genus *Ibalia*.

The species of the next genus (*Figites*) have the abdomen thickened and rounded above, the antennæ gradually thickened towards the apex, but one brachial cell, the radial very distant from the apex of the wing, and the second cubital wanting.

In the genus *Cynips* the abdomen is similar to the last, but the antennæ are filiform; there are three cubital cells to the wing, the first of which is large; the radial is elongated, and there is but one complete cell at the base of the wing. [GALLS.]

GALLI'NÆ, Gallinaceous Birds, the fifth order of the class *Aves*, according to Linnæus, who thus characterises it:—Bill (a reaping sickle, 'Harpa colligens') convex; the upper mandible arched over the lower; nostrils over-arched by a cartilaginous membrane. Feet formed for running; the toes rough below. Body sebaceous, muscular, delicate (purum). Food: grain collected on the earth and macerated in the crop (ingluvies). Nest artless and placed on the ground; eggs numerous; food pointed out to the young by their parent. Polygamous. Analogous to the order *Pecora* in the class *Mammalia*. [RASORES.]

GALLINSECTA. [COCCIDÆ.]

GALLINULA. [RALLIDÆ.]

GALLIONELLA, a genus of Plants belonging to the natural order *Diatomaceæ*, and to Kützing's family *Meloseireæ*. [MELOSEIREÆ.]

GALLS are the result of a morbid action excited in the leaf-buds of several species of the genus *Quercus*, or Oak.

The galls of commerce are chiefly those which occur on the *Quercus infectoria* (Ollivier). They vary in size from that of a pea to that of a nutmeg.

They originate in the puncture of an insect, *Cynips gallætinctoriæ*. The puncture is effected by the ovipositor of the insect, and an egg is at the same time deposited. An interruption in the ordinary functions of the tissues of the plant takes place at the spot where the egg is inserted; the consequence is an excrescence of vegetable matter, principally tannin, formed round the egg, and furnishes a nidus for the grub or larva when hatched. When this takes place the grub eats its way out through the side of the gall; after which the vitality of the excrescence either decreases or ceases altogether. The surface has irregular elevations or lines, with the interspaces generally smooth. The colour is white or yellow in one variety; green, gray, or black in another. The white variety, which is the largest, often has a hole in the substance of the shell by which the larva has escaped. This kind is the least powerful and least esteemed. The best Galls come from Aleppo and Smyrna, but are often mixed with those from Syria and Cyprus. In 100 parts of Aleppo Galls Sir H. Davy found gallic acid, 6·2; tannin, 26; gum and insoluble tannin, 2·4; lime and other salts, 2·4; woody fibre, 63. Braconnot also found ellagic acid. Galls are devoid of smell, but have a disagreeably bitter taste, with a powerfully astringent action. The whole of their soluble matter is yielded to forty times their weight of boiling water; ether dissolves about half their weight, alcohol considerably more.

They yield a fine black colour with any of the salts of iron, and are used in the preparation of writing ink. The quantity imported is annually about 700 tons. A kind of gall has lately been imported from China. Dr. Pereira describes it in the 'Pharmaceutical Journal' under the name of Woo-pei-tze; they are of very irregular shape, more bulky than the common galls, and hollow, the external shell being only about $\frac{1}{37}$ of an inch in thickness, very brittle, and of a brownish-yellow colour. Mr. Doubleday says that the producing insect in this case is one of the *Aphis* tribe. They are extremely astringent, but have not yet been used in dyeing.

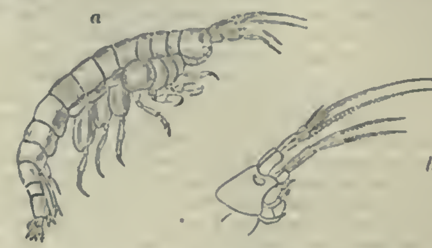
The infusion possesses all the valuable properties of the gall, as does an alcoholic tincture; but decoction is an objectionable preparation. For internal use the infusion is preferable to the powder, which, like all substances containing much woody fibre, irritates the stomach. Galls may be employed in powder to form an ointment, which with opium and camphor is of great service in painful hæmorrhoids. As a tonic in intermittent fever, and as an astringent in hæmorrhagic or other discharges, galls are occasionally employed. But the most extensive use is made of them in the arts, and as a chemical test.

GAMBOGE, GAMBOGIA. [GARCINIA; HEBRADENDRON.]

GA'MMARUS, a genus of Animals belonging to the Amphipodous Crustaceans, the Crevettes or Chevrettes of the French. It has the following characters:—Antennæ inserted in front of the head between the eyes, moderate, composed of three principal joints and a fourth which is setaceous, multiarticulate and terminal; the upper antennæ with a small, setaceous, multiarticulate appendage at the internal extremity of their third joint. The four anterior feet terminated by a large compressed hand provided with a strong hook or moveable finger, which applies itself upon the lower edge; the next four feet terminated by a single joint, or slightly curved nail; the last six longer, raised on the sides of the body, and with a delicate and straight terminal joint. There are long bifid very moveable filaments on each side under the tail, which is terminated by long, ciliated appendages, which are extended nearly in the direction of the body, and which constitute a sort of spring, by means of which the animal executes considerable leaps, or aids its swimming by a backward impulse on the water. Body oblong, very much compressed, arched, divided into thirteen segments (including the head); each segment furnished above with a crustaceous, delicate, semi-transparent, transverse lamina or blade, and the first seven also furnished with a lateral crustaceous piece which covers the base of the feet. (Desmarest.)

G. Pulex, Fabricius and Latreille (*Cancer Pulex*, Linnæus; *Squilla Pulex*, De Geer; *Squilla fluviatilis*, Merrett; *Gammarus aquaticus*, Leach; Crevette des Ruisseaux, Geoffroy), the Fresh-Water Shrimp. This crustacean, which abounds in springs and rivulets, always swims near the bottom on its side, and its progression is principally performed by the rapid jerks of the appendages of the tail. The animal is carnivorous and feeds principally on dead fishes, and often on the carcasses of its own species. The male may often be seen swimming coupled with the female, which is much smaller, and which he holds between his legs. She keeps her eggs till they are hatched, and the young for some time seek shelter under her abdomen and the lateral appendages of her body.

There are some marine species; and Desmaret observes that the genus bears the strongest analogies to those genera which have been separated from it, in his opinion on sufficiently slight grounds, under the names of *Leucothöe, Dexamine, Melita, Mæra, Pherusa, Amphithöe, Orchestia*, &c. The greater part of these, M. Desmaret states, have not been adopted by the more recent authors on the natural history of the Crustaceans; and the only ones which had been generally admitted when he wrote were *Talitrus* and *Corophium*. *Cerapus* of Say he considers to be founded on sufficient characters. M. Latreille however, in the fourth volume of Cuvier's 'Règne Animal' (ed. 1829), admits them all.



Fresh-Water Shrimp (*Gammarus Pulex*).
a, animal, magnified; *b*, the head and antennæ of the same, highly magnified.

Gammarus (*Amphipoda*) is noticed by Mr. Westwood as one of the types of each of the great groups of the typical Malacostracous *Crustacea*, which have been ascertained to undergo no change of form sufficiently marked to warrant the employment of the term metamorphosis. ('Phil. Trans.,' 1835.) [COROPHIUM.]

GAMPSONYX. [FALCONIDÆ.]

GANGA. [TETRAONIDÆ.]

GANNET. [PELECANIDÆ.]

GA'NODUS, a genus of Fossil Ganoid Fishes from the Oolite of Stonesfield; 7 species. (Egerton.) Referred to *Chimæra* by Agassiz.

GANOID, a grand division of Fossil Fishes in the classification of M. Agassiz. [FISH.]

GANYME'DA (Gray), a genus of Radiated Animals allied to the *Echinidæ* and the *Asteriadæ*, and which is thus characterised:—

Body hemispherical, depressed, thin, chalky, hollow. The back rounded, rather depressed, flattened behind, with a rather sunk quadrangular central space. The sides covered with sunken angular cavities, with a small round ring, having an oblong transverse subcentral hole in their base. Underside small, rather concave, with five slight sloping elevations from the angles of the mouth to the angles of the rather pentagonal margin. The edge simple. The mouth central. Vent none. Cavity simple. Parietes thin and minutely dotted; centre of the dorsal disc pellucid.

The genus, in Dr. Gray's opinion, is very nearly allied to Goldfuss's *Glenotremites paradoxus* ('Petrifact.' tab. 49, f. 9, and t. 51, f. 1), but Dr. Gray points out the differences, and is induced to consider these two genera as forming a family or order between the *Echinidæ* and *Asteriadæ*; allied to the latter in having only a single opening to the digestive canal, and agreeing with the former in shape and consistence, but differing from it in not being composed of many plates.

Dr. Gray only knew of two specimens of *Ganymeda*, which he believes were found on the coast of Kent, as he discovered them mixed with a quantity of *Discopora Patina*, which he collected several years ago from fuci and shells on that coast. Size of specimens one-eight of an inch in diameter. *Ganymeda pulchella* (Gray) is the name of the species. ('Zool. Proc.,' 1834.)

GAR-FISH, GAR-PIKE. [BELONE; ESOX.]

GARCI'NIA, a genus of Plants belonging to the natural order *Guttiferæ*, named in honour of Dr. Garcin, who travelled in the East Indies. It formerly consisted of few species, but no less than 21 are enumerated by Dr. Wallich, 10 of which he considers new. These are distributed over the islands of the Indian Archipelago, in the southern parts of China, in the Indian and Malayan peninsulas, in Asam and Silhet, with one species (G. Cowa) extending as far north as Monghir on the Ganges. They are all trees of considerable size, with opposite coriaceous shining oval leaves; numerous flowers, which are monœcious or diœcious; in the male, stamens numerous, inserted on a large fleshy 4-lobed receptacle, anthers bursting longitudinally; in the female, stamens numerous but imperfect, ovary 4-10-celled, ovules solitary. The fruit fleshy and juicy, crowned with the peltate stigma, is edible in many of the species.

G. Mangostana is the most remarkable species, being the far-famed Mangosteen (Mangees, Marsden) of the Malays, reckoned one of the most delicious of all fruits, and not alone of the countries where it is indigenous, but, as Marsden says, "is the pride of the Malay Islands, and perhaps the most delicate fruit in the world." It is a native of the Malayan Peninsula and of the islands to the eastward of the Bay of Bengal, forming trees of considerable size, with a straight trunk and numerous spreading opposite branches forming an elegant conical head. The tree is considered one of the most ornamental in Batavia for gardens, also as affording an agreeable shade. Bontius compares their appearance to that of citron-trees. It is in flower and fruit a great part of the year, according to Roxburgh, but Marsden says "the returns of its seasons are very irregular." So wedded is it to its indigenous soil and climate, that the innumerable attempts made to cultivate it elsewhere have uniformly failed. Dr. Roxburgh says, "For these 35 years past I have laboured in vain to make it grow and be fruitful on the continent of India. The plant has uniformly become sickly when removed to the north or west of the Bay of Bengal, and rarely rises beyond the height of two or three feet before it perishes." The male and female flowers are sometimes on the same, but usually on separate trees. The germ is superior, round, from 6- to 8-celled, with one ovule in each, attached to the middle of the axis. The ripe berry is spherical, of the size of a pretty large apple, having the surface even, and crowned with the permanent peltate 6- to 8-lobed stigma. The rind is thick, firm, though somewhat spongy, of a dull-crimson colour, sometimes compared to that of the pomegranate. Seeds as far as 8 in number inclosed in a very abundant soft fleshy envelope which is delicately white, forming the edible part of the fruit, described as delicious to the taste and as dissolving away in the mouth. It is also extremely innocent in its nature, as almost any quantity of it may be eaten without detriment, and persons sick of almost any disease are allowed to partake freely of it without inconvenience. The fruit before ripening is slightly acid. The rind is powerfully astringent, and its decoction is employed in dysentery and as a gargle in aphthæ of the mouth. The bark of the trunk and branches is also considered astringent, and said to be employed by the Chinese in dyeing.

G. cornea has oblong elliptic leaves, solitary and umbellate flowers, lateral, terminal, and drooping; the stigma entire; the berry the size of a plumb. It is a native of the East Indies in the high remote mountains of Amboyna. The trunk of this tree is very lofty, but not very thick, it is covered with a black bark. The branches extend wide, and divide into many short branches, which have a pair of leaves at each joint, these are large, from 11 to 15 inches long and 4 inches broad, but on old trees shorter, smooth, firm, and shining. The flower rises between the upper leaves, drooping, having the form of a small rose, of a yellow colour. The fruit is crowned by the entire stigma, which appears like a wart. It is of a dusky-brown or smoky colour on the outside, and within it has a mucous pulp, in which lie a few seeds in the shape of a half-moon. It has a resinous smell when fresh. The wood is heavy, and very hard like horn; it is used for the handles of tools, and the young ones in building, the old ones being too hard to work.

G. Cambogia has elliptic leaves tapering to both ends, terminal solitary flowers, yellowish corollas, an 8-lobed stigma, the berry 8-furrowed. It is a native of Malabar and other parts of the East Indies. It is a tall tree with a trunk as thick as two men can compass, with spreading opposite branches. The leaves are 5 inches long and half that in breadth. The fruit is about 2 inches in diameter, drooping on peduncles, 1 inch in length; the rind is thin, smooth, and yellowish, the pulp is yellow, succulent, sweet, and eatable. It is very common about Siam and Cambodia, where incisions are made in the bark, and a quantity of gum-resin, called Gamboge, flows out, and is exported to foreign countries.

It is called by the natives of Travancore Gharka Pulli, and is therefore inferred to be *Carca Pulli* of old writers. In Ceylon the fruit is called Goraka, and much used by the natives in their curries; when ripe it is said to form a fine fruit as large as the Mangosteen. Mrs. Colonel Walker, in her letters to Dr. Graham, describes the outer husk of the fruit as being prepared by the natives by taking out the pulp and seeds, bruising and then heaping it up until the whole is soft. It is then smoked and kept within the influence of smoke, being much used as a favourite ingredient in their curries and also for preserving, along with salt, a small kind of fish, which thus cured will keep for six or seven months.

The name *Cambogia* is derived from the province Camboja, or Cambodge, whence it comes.

G. Cambogia, *G. Cowa*, *G. lanceæfolia*, *G. Kydia*, *G. pedunculata*, and *G. paniculata*, all yield a kind of edible fruit, but of these the last is most like the Mangosteen. From incisions made in the branches a yellow juice exudes, and soon concretes, having a close resemblance to, and in fact forming an inferior kind of gamboge; whence it has been inferred that the commercial gamboge is yielded by tho species. Later investigations have proved the incorrectness of the opinion, and the true gamboge-tree of Ceylon has been determined to belong to a new genus named *Hebradendron*. [HEBRADENDRON.] *G. Zeylona*, *G. cornea*, and *G. pictoria* (the last also supposed to be a species of *Hebradendron*), all yield an inferior kind of gamboge.

GARDE'NIA (named after Dr. Alexander Garden of Charlestown, South Carolina, a correspondent of Linnæus), a genus of Plants belonging to the natural order *Cinchonaceæ*. It has the calyx usually ribbed, with a tubular truncate limb divided into several lobes or teeth; the corolla funnel-shaped, or approaching salver-shaped, with a tube much larger than the calyx, and a contorted spreading 5-9-parted limb; the anthers 5-9, linear, sessile in the throat; the stigma clavate, bifid, or 2-toothed, with thick erect lobes; the dissepiments of the ovary 2-5, incompletely dividing it into cells; the berry fleshy, crowned with the calyx, with a papery or bony lining, incompletely 2-5-celled; the seeds immersed in fleshy parietal placentæ. The species are armed or unarmed trees or shrubs, with axillary or terminal, usually solitary, white and fragrant flowers.

G. campanulata is a shrubby plant with short branches, spiny at the apex, the spines solitary; the leaves lanceolate, smooth, acuminated at both ends; the flowers on short pedicels in terminal and lateral fascicles; the limb of the calyx campanulate, with a short acutely 5-toothed border; the corolla sub-campanulate, 5-lobed; the berry, roundish, ovate. This plant is a shrub 5 to 10 feet in height, and is a native of the East Indies, in the forests of Chittagong. The berry, is about the size of a golden pippin apple, and is employed by the natives of India as a cathartic and anthelmintic.

G. arborea is an unarmed tree with ovate-oblong leaves, terminal, almost sessile flowers, usually arranged in threes; the corolla with a filiform tube and a 5-parted limb; the berry drupaceous, smooth, containing a 4-5-valved shell. It is a native of the East Indies. The fruit is eaten by the natives of India. It is one of the most beautiful species of the genus, and deserves a place in every collection.

There are about 50 species of *Gardenia*, which all bear elegant sweet-scented flowers. They thrive best in a mixture of loam, peat, and sand. Under the name of Cape Jasmines, double-flowered varieties of *G. florida* and *G. radicans* are extensively cultivated. Their flowers are very fragrant, and the best way of getting them to bloom freely is to set them in a close frame with a gentle bottom heat in the spring. In the winter they may be placed in the greenhouse. They may be increased by cuttings.

(Lindley, *Flora Medica;* Don, *Dichlamydeous Plants.*)

GARLIC. [ALLIUM.]

GARLIC-PEAR. [CRATÆVA.]

GARNET, a well-known precious stone, of which there are many varieties. Some of them are probably distinct species; but agreeing in form, and some other properties, they are classed together. This mineral occurs crystallised, massive, and granular. The primary form is a cube, but it occurs in the form of a rhombic dodecahedron. The colour is various, and accordingly, as will be seen below, it has received different names. It is transparent, translucent, rarely opaque. Lustre vitreous, resinous. Specific gravity, 3·6 to 4·2. Hardness, 6·5 to 7·5. Cleavage parallel to tho planes of the rhombic dodecahedron; fracture uneven.

This mineral occurs in the mountainous parts of most countries.

The massive varieties are amorphous, structure granular, compact. The crystalline varieties, according generally to their colour, have received various names. Precious Garnet, *Almandine;* black, *Melanite*, *Pyreneite;* greenish-yellow, *Grossularia;* yellow, crystallised, *Topazolite;* granular, *Succinite;* brownish-yellow, granular, *Colophonite;* greenish, compact, *Allochroite;* red, *Pyrope*, Carbuncle; reddish-brown, *Essonite*, Cinnamon-Stone, *Romanzovite;* magnesian, *Rothoffite.*

Tho following are the analyses of the *Almandine*, by the authors named, and from the places mentioned:—

	Bohemia.	New York.
Silica	33·75	42·51
Alumina	27·25	19·15
Oxide of Iron	36	33·57
Oxide of Manganese	0·25	5·49
Lime		1·07
	97·25 Klaproth	101·79 Wachtmeister.

It appears that the essential ingredients of the Garnet are silica, alumina, and oxide of iron; these are frequently partially replaced by oxide of manganese, lime, and magnesia.

Garnet occurs abundantly in mica-slate, hornblende slate, and gneiss, and less frequently in granite and granular limestone. It is found sometimes in serpentine and lava.

The best precious Garnets are from Ceylon and Greenland. *Grossularite* occurs in the Wilin River, Siberia, and at Tellemarken in Norway; green Garnets are found at Swartzenburg, Saxony; *Melanite* in the Vesuvian Lavas; *Ouvarovite* at Bissersk in Russia; *Topazolite* at Mussa, Piedmont; *Aplome* in Siberia on the Lena, and at Swartzenburg. Garnets also occur in several parts of the United States.

The Garnet is the Carbunculus of the Romans. The Alabandic Carbuncles of Pliny were so-called because they were cut and polished at Alabanda. Hence the name *Almandine.*

The clear deep red Garnets make a rich gem, and are much used for ornament. Those obtained from Pegu are most valued. They are cut quite thin on account of their deep colour. Cinnamon-Stone is also used for the same purposes. Garnet when powdered is used for the same purposes as emery.

(Dana, *Mineralogy.*)

GARROT. [DUCKS.]

GARRULUS. [CORVIDÆ.]

GARRYA, the only genus and type of the natural order of Incomplete Plants, *Garryaceæ*. It was named by Mr. Douglas in compliment to Nicholas Garry, Esq., secretary to the Hudson's Bay Company. Tho flowers of this genus are unisexual, the staminiferous and pistiliferous flowers being upon distinct plants. The staminiferous flowers are in pendulous catkin-like racemes, within connate bracteæ. They have a 4-leaved calyx and 4 stamens. The pistiliferous flowers are in pendulous racemes like the others, but with a 2-toothed calyx, connate with the ovary, which is 1-celled. They have two setaceous styles, two pendulous ovules, with funiculi as long as themselves. The fruit is a berried pericarp, not opening, and containing two seeds. The embryo is very minute in the base of a great mass of fleshy pulp. The leaves are simple, opposite, exstipulate, evergreen, serrated or entire. The species are shrubs, natives of California and Mexico. Only two species of this genus have been introduced into Great Britain; they are very ornamental and grow best in a loamy soil, and may be propagated by layers.

G. elliptica, the Elliptic-Leaved Garrya, has, when young, soft pubescent purplish branches; when older, they become smooth and grayish. The leaves are dark-green, shining above, hoary beneath, with simple twisted, interwoven hairs. The flowers are of a greenish or yellowish-white, and are in bloom from November to February. Only the stamen-bearing plant is in this country. During the season of blossoming this shrub presents a striking and beautiful appearance, with its delicate pendulous catkins, which are from eight inches to a foot in length. It is easily cultivated in our gardens, and is as hardy as the common laurustinus.

G. laurifolia has elliptic oblong leaves either entire or very minutely dentate. Both the staminiferous and pistiliferous flowers are solitary, sessile, and opposite, having one in every bract. This species, like the former, is an evergreen shrub or low tree, and grows on the mountains of Mexico. According to Loudon there is but one specimen of this very beautiful and desirable shrub preserved in the garden of the Horticultural Society. It was brought over in the year 1839. There are some other species of *Garrya* recognised by various botanists: *G. Lindleyi*, considered by Mr. Bentham as a variety of *G. laurifolia; G. macrophylla, G. oblonga*, and *G. ovata* are described in Bentham's 'Plantæ Hartwegianæ' from specimens collected by Mr. Hartweg in different parts of Mexico.

(Loudon, *Encyclopædia of Trees and Shrubs.*)

GARRYACEÆ, *Garryads*, a small natural order of Plants related to *Juglandaceæ, Caprifoliaceæ*, and *Helwingiaceæ*. The species are shrubs with opposite leaves without stipules. The flowers are arranged in pendulous amentaceous racemes within connate bracts. The wood is without distinct concentric zones or dotted ducts. The flowers are unisexual and amentaceous. There are four stamens alternate with the four sepals, not elastic. The pericarp is berried, indehiscent, 2-seeded; the embryo very minute, in the base of a fleshy albumen. The two genera of this family are *Garrya* and *Fadgenia*. They are found in North America in temperate latitudes, or in the West Indies. They have the appearance and habit of viburnums or dogwoods.

GARVIE, a local name for the Sprat. [CLUPEIDÆ.]

GASTEROMYCE'TES, a sub-order or cohort of Plants belonging to the natural order *Fungi*. [FUNGI.] It is distinguished from the higher forms of *Fungi* [HYMENOMYCETES] by the reproductive organs being included in a case of some kind or another.

The first tribe of the *Gasteromycetes* is *Angiogastres*. Of this tribe there are four sub-tribes or sections. The first, *Phalloidei*, has a distinct receptacle at length bursting through the excipulum. Of this section the genus *Phallus* is the type. [PHALLUS.]

The second section is *Tuberaceæ*. [TUBERACEÆ.]

The third section, *Nidulariaceæ*, has a receptacle filled with free or elastically pedicellate sporangia. The type of this section is *Nidularia*, or Bird's-Nest Peziza. There are three species of this genus found in Great Britain. [NIDULARIACEÆ.]

The fourth section, *Carpoboli*, have a solitary sporangium protruding from the receptacle. The genera belonging to it are *Carpobolus, Sphærobolus, Thelebolus, Pilobolus, Atractobolus.*

A species of the last named, *A. ubiquitarius*, is found on wood, stones, and other things, after rain, appearing like scattered meal. The Rev. M. J. Berkeley says however that he is convinced that it is of insect origin. *Sphærobolus stellatus* is found on rotten wood and sticks, in the autumn. In its early state it is covered by a fine woolly or cottony web, which is very fugacious. When the young plants have pushed through this web, they have the appearance of mustard-seeds. Each plant consists of an outer and an inner membrane. At the time of the opening of the outer membrane, the inner one, which is then concave, and with its mouth uppermost, projects the ball of sporules which it contains, like a bomb from a mortar, to a distance of several inches. The cracking noise occasioned by this phenomenon is so great as to be distinctly audible at some distance. "This is unquestionably," says Dr. Greville, "the most wonderfully constructed plant which it has fallen to my lot to describe. That so great a degree of force should exist in a body not larger than a pin's head, and that force exerted in defiance of considerable resistance, seems to surpass the power of anything to account for it satisfactorily."

The tribe *Pyrenomycetes* is frequently regarded as a sub-order or cohort. [FUNGI.] It consists of genera having more or less the characters of *Sphæria*. [SPHÆRIA.] Most of the species are found on the decaying leaves of other plants, and vary with the species of the plant on which they grow. The genera in which the greatest number of species have been described by British botanists are *Cytispora, Phoma, Dothidea, Asteroma, Rhytisma, Phacidium, Hysterium*, and *Leptostroma*. [PYRENOMYCETES.]

The third tribe is *Trichospermi* [TRICHOSPERMI]; the fourth, *Trichodermacei*. [TRICHODERMACEÆ.]

The fifth tribe, *Perisporiacei*, has a peridium scarcely distinct from the nucleus, and the sporidia immersed in pulp, free or included in peridiola. The genera in this tribe are not numerous. *Racodium*, the Mouse-Skin Byssus, is placed here by some authors; by Fries in *Byssaceæ*. [BYSSACEÆ.]

The most extensive genus is *Erysiphe*, the species of which produce various forms of mildew. It has a fleshy peridium opening at the collapsing apex, sub-gelatinous within; the sporidia included in one or more peridiola, often including sporidiola; the thallus floccose, effused, free.

E. pannosa, the Rose-Mildew, is found on the leaves of the various species of rose. It is easily known by its shining clothy aspect, which is very different from the rest of the genus. On this account it is referred by Fries to *Eurotium*.

E. communis is an extremely common fungus, and is found on various kinds of herbaceous plants. It is not improbable that the various forms of *Erysiphe*, which have been described according to the species of plant on which they grow, have a common origin. The same may be said of the forms of *Uredo, Æcidium*, and *Puccinia*. [MILDEW; UREDO.]

The sub-order *Hyphomycetes* of Berkeley and others includes many of the genera that are referred by Fries to the fourth order, *Coniomycetes*. The first tribe, *Cephalotrichei*, includes the genera *Isaria, Anthina*, and *Ceratium*. The species of the first two are not numerous or common. *Ceratium hydnoides* is not uncommon on rotten wood.

The tribes *Mucori, Dematiei*, and *Mucedines* consist of various genera of plants forming moulds, mildews, blights, brands, &c. [MILDEW; MOULDINESS; SPORENDONEMA.] Some of the species placed in these tribes by Berkeley are described under BYSSACEÆ.

The tribe *Sepidoniei* includes the genera *Sepidonium, Epochnum, Psilonia*, and *Fusisporium*. They have all a floccose mycelium, without any distinct sporidiferous filaments; and the sporidia, heaped together, lying upon and in general springing from the matrix. The species of *Fusisporium* are found in decaying fruits and vegetables. [FUNGI; ENTOPHYTA.]

The last sub-order, *Coniomycetes*, embraces those *Fungi* whose sporidia are produced beneath the epidermis of plants, and which in many instances appear to be rather diseases of the tissue than independent existences. The first sub-section or tribe is *Tubercularini*. [TUBERCULARINI.] The second tribe, *Stilbosporei*, consists of sporidia glued together into a nucleus, without any covering, under the cuticle of plants, at length bursting forth together with the gelatine or free. The genera of this tribe are *Nemaspora, Septoria, Stilbospora, Didymasporium*, and *Melancorium*.

The third tribe, *Sporidesmiei*, have their sporidia chained together into flocci. The genera are *Aregma, Torula*, and *Spilocæa*.

The fourth tribe, *Hypodermii*, includes those species of *Fungi* which are found underneath the cuticle of living plants. They are said by Fries to have "no proper vegetation, their sporidia arising from an anamorphosis of the cells of living vegetables." To this definition Berkeley objects, and regards the species as distinct plants. The principal genera are *Puccinia, Æcidium*, and *Uredo*. [ÆCIDIUM; UREDO.]

GASTERO'PODA, the third class of Mollusks, according to the system of Cuvier, who remarks that it is very numerous, and that an idea may be formed of it from the Slugs and Shell-Snails. Before we proceed to the sections, or rather orders, into which Cuvier has subdivided this extensive congregation, it will be necessary to put the reader in possession of his views of the conformation necessary to bring a molluscous animal within the class of Gasteropods.

These mollusks generally creep upon a fleshy disc placed under the belly; but which sometimes takes the form of a furrow or that of a vertical plate. The back is furnished with a mantle, which is more or less extensive, presents diversities of form, and, in the greatest number of genera, produces a shell. The head, placed in front, shows itself more or less, according to its greater or less retirement under the mantle, and is furnished with small tentacles, which are above the mouth, and never surround it. Their number ranges from two to six, and they are sometimes altogether wanting. Their proper use is only for touching, and, at the most, for smelling. The eyes are very small, sometimes adhering to the head; sometimes at the base, or at the side, or at the point of the tentacle; and sometimes these organs are altogether wanting. The position, the structure, and the nature of the respiratory organs vary, and afford grounds for dividing the animals into many families; but they never have any other than a single aortic heart, that is to say, placed between the pulmonary vein and the aorta. The site of the apertures by which the organs of generation come out and that of the vent vary; but they are nearly always on the right side of the body.

Many of the Gasteropods are absolutely naked; others have only a concealed shell; but the greater number carry a shell, which is capable of receiving and sheltering them.

These shells are produced in the thickness of the mantle; some of them are symmetrical, consisting of more pieces than one; others are symmetrical, but formed of a single piece; and there are also some non-symmetrical, which in species where they are very concave, and where they grow a long time, necessarily produce an oblique spire. If the reader will imagine an oblique cone in which other cones are successively placed, always larger in a certain direction than in the others, it will follow that the whole rolls itself upon the side which is least. The part on which the cone is rolled is called the Columella, or Pillar: this is sometimes solid, and sometimes hollow. When it is hollow, the open end of it is named the Umbilicus. The whorls of the shell may remain nearly on the same plane, or may extend towards the base of the columella. In the last case, the preceding whorls are raised one above the other, and form what is called the Spire, which is pointed in proportion to the more rapid descent and small enlargement of the whorls. Those shells with an elongated or projecting spire are termed Turbinated Shells. When, on the contrary, the whorls remain nearly on the same plane, and are not enveloped one within another, the spire is flat or even concave. These are called Discoid Shells. When the upper part of each whorl envelops the preceding ones, the spire is said to be concealed. That part of the shell from which the animal comes forth is termed the Aperture. When the whorls remain nearly on the same plane, the animal, when it creeps, carries its shell disposed vertically, the columella lying across the posterior part of the back; and its head passes under the border of the aperture opposed to the columella. When the spire is elongated it is directed obliquely to the right in almost all the species: a small number only have it directed to the left when they creep; these shells are called Reversed or Left-Handed Shells. The heart is always on the side opposite to that where the spire is directed. It is therefore ordinarily on the left side; in the reversed or left-handed shells it is on the right. The contrary of this disposition holds good with regard to the organs of generation.

The organs of respiration, which are always situated in the last whorl of the shell, receive the ambient element under its edge, sometimes by means of the mantle being entirely detached from the body along the whole length of this edge, sometimes in consequence of its being merely pierced by a hole. The border of the mantle is sometimes prolonged into a canal, so that the animal can advance to seek the surrounding fluid without exposing either its head or foot beyond the shell. For this purpose the shell, in such cases, has also on its edge, near to that end of the columella (the base) which is opposed to that whereto the spire tends (the apex), a notch or a canal for the lodgment of that of the mantle. The canal is consequently on the left in the ordinary species, and on the right in the reversed shells. The animal being very flexible is able to vary the direction of its shell, and most frequently when there is a notch or a canal it is directed forwards; the spire is thus behind, the columella on the left, and the opposite border, or external lip, as it is termed by some conchologists, on the right. A directly contrary disposition is manifested in the Reversed Shells, and these, in consequence of this contrary disposition, turn towards the left instead of turning towards the right, as in the normal structure. It follows as a consequence that the aperture of the shell, which is formed principally by the last whorl, is more or less large in proportion to the other whorls, accordingly as the head or foot of the animal, which is to be constantly protruded therefrom and retracted thereunto, is more or less voluminous compared with the mass of the viscera which remain fixed within the shell. The aperture is moreover wider or narrower in proportion as the same parts are more or less thick. There are shells whose aperture is narrow and long; the foot, in such cases, is delicate, and doubles together for the purpose of re-admission. The greater number of aquatic Gasteropods with a spiral shell have an Operculum, or separate piece, which is sometimes horny, sometimes calcareous, attached on the posterior part of the foot, and which shuts the shell when the animal has re-entered it and is entirely retracted within.

Cuvier, in continuation, remarks that there are Gasteropods with the sexes separate, and others which are hermaphrodites: of these last some have the power of reproduction without the aid of a second individual, while the others require a reciprocal copulation for the continuation of the species. He adds that the organs of digestion present as many differences as those of respiration, and he divides the class into the following orders:—

1. Les Pulmonés, *Pulmonifera* (*Pulmobranchiata* of De Blainville).

This order is distinguished from the Mollusks inasmuch as they respire the elastic atmospheric air by means of a hole opened under the border of their mantle, and which they dilate or contract at their pleasure. They have consequently no branchiæ, or gills, but only a net-work of pulmonary vessels, which creep around the walls and principally upon the plafond of their respiratory cavity. Some are terrestrial, others aquatic; but these last are obliged to come to the surface of the water from time to time, in order to open the orifice of their pectoral cavity for the purpose of respiration.

The Terrestrial Pulmoniferous Mollusks have all four tentacles; two or three only, of very small dimensions, have not permitted the observer to see the lower pair. They are divided into those which are naked, and those which are protected by a shell. They are all hermaphrodites.

Those which have no apparent shell formed the great genus *Limax* of Linnæus; and of these every one may find examples in the common slugs. [LIMAX.]

Parmacella and *Testacella* lead the way to those which have a complete and apparent shell, the borders of whose aperture, in the majority of instances, are reflected into a little roll (bourrelet) when the animal is adult. These were placed by Linnæus under his great genus *Helix*. The shell varies much in form; being for instance subglobular or subdiscoid, as in many of the shell-snails; or elongated and pyramidal, as in *Bulinus*, &c. [HELICIDÆ.]

The Aquatic Pulmoniferous Mollusks have only two tentacula, and always come to the surface to breathe; they do not therefore inhabit deep waters, but live for the most part in the fresh waters or salt lakes, or at least near the sides and mouths of rivers.

Cuvier goes on to give *Onchidium*, Buchanan (*Peronia* of De Blainville) [NUDIBRANCHIATA], as an example of the Aquatic Pulmoniferous Mollusks without shells.

Those with shells, which are sometimes discoid, as in *Planorbis*, or elongated and pyramidal, as in *Limnæa*, &c., he illustrates by the genera *Physa*, *Scarabæus*, *Auricula*, and *Conovulus*.

2. *Nudibranchiata* (*Polybranchiata—Tritonia*, &c., of De Blainville).

The Mollusks composing this order have no shell nor any pulmonary cavity; but their branchiæ are naked, and placed upon some part of the back. They are all hermaphrodites and marine. They often swim reversed, with the foot concave like a boat, at the surface, aiding their progression with their mantle and tentacles as with oars.

3. *Inferobranchiata*.

This order presents nearly the same form and organisation as the *Dorides* and *Tritoniæ*: but their branchiæ, instead of being placed upon their backs, are arranged in two long rows of leaflet-like appendages on each side of the body under the projecting border of the mantle. *Phyllidia* and *Diphyllidia*, Cuvier, belong to the *Inferobranchiata*.

4. *Tectibranchiata* (*Monopleurobranchiata* of De Blainville).

This order has the branchiæ attached either along the right side or upon the back, in the form of leaflets, which are more or less divided, but not symmetrical. The mantle covers the branchiæ more or less, and almost always contains in its thickness a small shell. The *Tectibranchiata* approach the *Pectinibranchiata* in the form of the organs of respiration, and live like them in the sea; but the *Tectibranchiata* are all hermaphrodites, like the *Nudibranchiata* and *Pulmonifera*. The genera *Pleurobranchus*, Cuv., *Pleurobranchæa*, Meckel, *Pleurobranchidium*, De Blainville; *Aplysia*, Linn.; *Dolabella*, Lam.; *Notarchus*, Cuv.; *Bursatella*, Blainv.; *Akera*, Müll.; *Bullæa*, Lam.; part of *Bulla*, Linn.; *Gasteroptera*, Meck.; *Umbrella*, Lam.; *Gastroplex*, Blainv.;—belong to this order. [BURSATELLA; BULLIDÆ; TECTIBRANCHIATA; PATELLIDÆ.]

5. *Heteropoda*, Lam. (*Nectopoda*, Blainv.).

Distinguished from all the others, inasmuch as their foot, instead of forming a horizontal disc, is compressed into a muscular vertical plate, which serves them as a fin, and at the edge of which, in many species, a dilatation, in form of a hollow cone, represents the disc of the other orders. Their branchiæ, formed of feathery lobes, are situated on the posterior part and left side of the back, directed forwards; and immediately behind them are the heart and a liver of no great size, with a part of the viscera and the internal organs of generation. Their body, lined with a muscular coat, is elongated, terminating most frequently by a compressed tail. Their mouth is formed by a muscular mass, and is furnished with a tongue beset with small hooks. The œsophagus is very long, the stomach delicate in texture, and two tubes at the right side of the packet of viscera give exit to the excrements and to the ova or to the prolific fluid. They generally swim with the back downwards and the foot above, and they can swell out their bodies by filling them with water by means which are not as yet well understood.

To this description Cuvier adds, that the method of swimming above described having induced Péron to believe that the natatory plate was on the back, and the heart and branchiæ under the belly, has given rise to many errors as to the proper place of these animals. Cuvier adds, that the examination of their nervous system led him to the opinion expressed in his memoir on the *Mollusca*, that they were analogous to the Gasteropods. A more complete dissection, he observes, made since, and that given by Poli, in his third volume, have completely confirmed this conjecture, and he states that the fact is that the *Heteropoda* differ but little from the *Tectibranchiata*. M. Laurillard believes that the sexes are always separate. Cuvier also remarks, that M. De Blainville makes of his (Cuvier's) *Heteropoda* a family which he names *Nectopoda*, and unites them with another family which he names *Pteropoda*, and which comprehends none of Cuvier's *Pteropoda*, except *Limacina*. To this, Cuvier observes, M. de Blainville refers *Argonauta*, upon what conjecture Cuvier knows not.

Forskal places all the *Heteropoda* of Cuvier under his genus *Pterotrachea*. [CARINARIA; ATLANTIA; HETEROPODA.]

6. *Pectinibranchiata* (*Paracephalophora Dioica*, Blainv.).

This order is by far the most numerous division of the Gasteropods, for it embaces nearly all those which have spiral univalve shells, and many of those whose shells are simply conical. Their branchiæ, composed of numerous leaflets or fringes (lanières) ranged in parallel order like the teeth of a comb (whence their name), are attached upon one, two, or three lines, according to the genus, to the plafond of the pulmonary cavity, which occupies the last whorl of the shell, and which forms a large opening between the border of the mantle and the body. Two genera only (*Cyclostoma* and *Helicina*) have, in the place of branchiæ, a vascular net covering the plafond of a cavity similar in other respects: these are the only genera which breathe air; all the others respire water.

All the *Pectinibranchiata* have two tentacula, and two eyes sometimes carried on their proper peduncles, a mouth in form of a proboscis, which is more or less elongated, and the sexes separate. The intromissive organ of the male, which is attached to the side of the neck, cannot ordinarily be retracted into the body, but is reflected in the branchial cavity, and is sometimes very large, as may be seen in the figure of *Buccinum undatum* [ENTOMOSTOMATA; BUCCINUM], which will give a general idea of the form of a marine Pectinibranchiate Testaceous Mollusk with a turbinated shell. *Paludina*, indeed, can cause this organ to re-enter the body by an orifice pierced at its right tentacle. The rectum and oviduct of the female creep also along the right side of the branchial cavity, and between them and the branchiæ is a particular organ composed of cellules containing a very viscous liquor, serving to form a common envelopment or case, which includes the eggs, and which the animal deposits with them. Several of these deposited ovaries present very complicated and singular forms, and may be often found on the sea-beach.

The tongue of the *Pectinibranchiata* is armed with small hooks, and files down the hardest bodies by slow and repeated friction.

The greatest difference among these animals consists in the presence or absence of the canal formed by a prolongation of the border of the pulmonary cavity of the left side, and which passes by means of a similar canal, or by a notch in the shell, so as to enable the animal to respire without leaving the shelter of its shell. Some of the genera again are without an operculum; and the species also exhibit differences in the filaments, fringes, and other ornaments exhibited on their head, their foot, or their mantle. These mollusks are arranged under many families, according to the form of their shells, which, generally speaking, present a sufficiently constant relation to the form of the animal. But the student should remember that this is not a rule without exception, as Dr. Gray has pointed out in his interesting paper in the 'Philosophical Transactions.'

In this work the reader will find the numerous genera—the leading ones at least—of this most extensive order, principally under the titles of the different families into which they have been separated by zoologists, and sometimes under their generic appellations.

7. *Tubulibranchiata.*

Cuvier considers that this order should be detached from the *Pectinibranchiata*, to which they nevertheless bear great resemblance, because their shell (which is in the form of a tube more or less irregular, the commencement of which only is turbinated or spiral) is fixed to different foreign bodies; they have in consequence no true copulative organs, and fecundate themselves. *Vermetus*, *Magilus*, and *Siliquaria* (all marine) belong to this order.

8. *Scutibranchiata* (*Paracephalophora Hermaphroditica*, with exception of the Chitons, De Blainv.).

This order consists of the Gasteropods which bear a near relationship to the *Pectinibranchiata* in the shape and position of the branchiæ, as well as in the general form of the body, but which have the sexes united in the same individual. The shells of this order are always without an operculum, very wide in the opening (some of them may be said to be almost all aperture), and many of them have shells without any turbination, so that they cover the animal, and especially its branchiæ, like a shield. The heart is traversed by the rectum, and receives the blood by two auricles, as in the generality of Bivalves. Under this order Cuvier, in his last edition of the 'Règne Animal,' places the *Haliotidæ* (Ear-Shells), *Stomatia*, *Fissurella*, *Emarginula*, and *Parmophorus*. [FISSURELLIDÆ; PATELLIDÆ.]

9. *Cyclobranchiata* (*Cervicobranchiata*, Blainv.).

Branchiæ in form of small leaflets or little pyramids, attached in a cordon more or less complete under the borders of the mantle, nearly as in the *Inferobranchiata*, from which the *Cyclobranchiata* are distinguished by their hermaphroditism; for they have no organs of copulation, and can reproduce the species without having recourse to a second individual. The heart does not embrace the rectum, but it varies in situation. [CHITONIDÆ; PATELLIDÆ.]

A general view of the structure and relations of the Shell-Fish is given under MOLLUSCA.

The following is a synopsis of the families and genera of *Gasteropoda* as given in Mr. Woodward's 'Manual of the Mollusca':—

Order PROSOBRANCHIATA.

Section A. *Siphonostomata.*
Family 1. *Strombidæ.*
Genera, *Strombus, Pterocerus, Rostellaria, Seraphys.*
Family 2. *Muricidæ.*
Genera, *Murex, Pisania, Ranella, Triton, Fasciolaria, Turbinella, Canedlaria, Trichotropis, Pyrula, Fusus.*
Family 3. *Buccinidæ.*
Genera, *Buccinum, Pseudoliva, Anolax, Halia, Terebra, Eburna, Nassa, Phos, Ringicula* (?), *Purpura, Purpurina, Monoceros, Pedicularia, Ricinula, Planaxis, Magilus, Cassis, Oniscia, Cithara, Cassidaria, Dolium, Harpa, Columbella, Oliva, Ancillaria.*
Family 4. *Conidæ.*
Genera, *Conus, Pleurotoma.*
Family 5. *Volutidæ.*
Genera, *Voluta, Cymba, Mitra, Volvaria, Marginella.*
Family 6. *Cypræidæ.*
Genera, *Cypræa, Erato, Ovulum.*
Section B. *Holostomata.*
Family 1. *Naticidæ.*
Genera, *Natica, Sigaretus, Lamellaria, Narica, Velutina.*
Family 2. *Pyramidellidæ.*
Genera, *Pyramidella, Odostomia, Chemnitzia, Stylina, Loxonema, Machrocheilus.*
Family 3. *Cerithiadæ.*
Genera, *Cerithium, Potamides, Nerinæa, Fastigiella, Aporrhais, Struthiolaria.*
Family 4. *Melaniadæ.*
Genera, *Melania, Paludomus, Melanopsis.*
Family 5. *Turritellidæ.*
Genera, *Turritella, Aclis, Cæcum, Vermetus, Siliquaria, Scalaria.*
Family 6. *Litorinidæ.*
Genera, *Litorina, Solarium, Phorus, Lacuna, Litiopa, Rissoa, Skenea, Truncatella, Lithoglyphus.*
Family 7. *Paludinidæ.*
Genera, *Paludina, Ampullaria, Amphibola, Valvata.*
Family 8. *Neritidæ.*
Genera, *Nerita, Pileolus, Neritina, Navicella.*
Family 9. *Turbinidæ.*
Genera, *Turbo, Phasianella, Imperator, Trochus, Rotella, Monodonta, Delphinula, Adeorbis, Enomphalus, Stomatella, Broderipia.*
Family 10. *Haliotidæ.*
Genera, *Haliotis, Stomatia, Scissurella, Pleurotomaria, Murchisonia, Trochotoma, Cirrus, Ianthina.*
Family 11. *Fissurellidæ.*
Genera, *Fissurella, Puncturella, Rimula, Emarginula, Parmophorus.*
Family 12. *Calyptræidæ.*
Genera, *Calyptræa, Crepidula, Pileopsis, Hipponyx.*
Family 13. *Patellidæ.*
Genera, *Patella, Aemæa, Gadinia, Siphonaria.*
Family 14. *Dentaliadæ.*
Genus, *Dentalium.*
Family 15. *Chitonidæ.*
Genus, *Chiton.*

Most of the families and more important genera are given under their proper names in this work.

GASTEROSTEUS, a genus of Fishes, with hard cheeks, belonging to the division *Acanthopterygii*. The common name of the species in this country is Stickleback. This genus is distinguished by the following characters:—Anterior dorsal represented only by free spines; body generally scaleless, but protected more or less at the sides by shield-like plates; ventrals reduced to a single spine; head without spines or tubercles; branchiostegous membrane with three rays.

Several species of Stickleback are found in the ponds and streams of this country, and one species is found in the salt-water; they are very active and voracious, and live upon aquatic insects and worms.

The most common species is the Three-Spined Stickleback (*Gasterosteus aculeatus*, Linn.), which is distinguished by the body being protected at the sides with shield-like plates, and the possession of three spines on the back. It is of an olive-colour above and silvery-white beneath, and varies from 2 to 3 inches in length. In the breeding season the males assume a pink hue on the under parts of the body, and the general colouring of the upper parts is brighter, and often green. According to Bloch this species spawns in April and June; and according to Cuvier in July and August.

The number of scaly plates varies in the sides of the body, and is supposed by some authors of high authority to afford specific characters. The following are the principal varieties or species established by Cuvier and Yarrell chiefly upon this character.

G. trachurus, Rough-Tailed Stickleback. (Yarrell, 'Brit. Fishes,' vol. i. p. 76.) The scaly plates extending the whole length of the sides; in number about 30.

G. semiarmatus, Half-Armed Stickleback (Yarrell). Lateral plates extending to a vertical line joining the vent and commencement of the soft dorsal; in number from 12 to 15.

G. leiurus, Smooth-Tailed Stickleback (Yarrell). Lateral plates extending only as far as the ends of the rays of the pectoral fins, where these last are laid back.

G. brachycentrus, Short-Spined Stickleback (Yarrell). Lateral plates not extending beyond the pectorals; dorsal and ventral spines very short.

The above are regarded as varieties of the *Gasterosteus aculeatus*, Linn., by Mr. Jenyns, who observes that that species "is subject to great variation, not only in the number of lateral plates, but in several other less obvious respects. The former may occasionally be found of every intermediate number between that which characterises the *G. leiurus*, Cuv., and that which appears in the *G. trachurus* of the same author. This number moreover is sometimes found constant in specimens which differ remarkably in other respects; at other times varying, when all other characters remain the same. From these circumstances combined, I feel satisfied that the above are mere varieties, notwithstanding the high authorities on which they stand recorded as distinct species." ('Manual of British Vertebrate Animals,' p. 349.)

A writer in the 'Magazine of Natural History,' vol. iii. p. 329, relates some interesting observations illustrative of the habits of these little fishes whilst in confinement in a tub. "When a few are first turned in, they swim about in a shoal, apparently exploring their new habitation. Suddenly one will take possession of a particular corner of the tub, or, as it will sometimes happen, of the bottom, and will instantly commence an attack upon his companions; and if any one of them ventures to oppose his sway, a regular and most furious battle ensues; the two combatants swim round and round each other with the greatest rapidity, biting and endeavouring to pierce each other with their spines, which on these occasions are projected. I have witnessed a battle of this sort which lasted several minutes before either would give way; and when one does submit, imagination can hardly conceive the vindictive fury of the conqueror, who, in the most persevering and unrelenting way, chases his rival from one part of the tub to another, until fairly exhausted with fatigue. They also use their spines with such fatal effect, that, incredible as it may appear, I have seen one during a battle absolutely rip his opponent quite open, so that he sank to the bottom and died. I have occasionally known three or four parts of the tub taken possession of by as many other little tyrants, who guard their territories with the strictest vigilance; and the slightest invasion invariably brings on a battle. These are the habits of the male fish alone; the females are quite pacific; appear fat, as if full of roe; never assume the brilliant colours of the male, by whom, as far as I have observed, they are unmolested."

Dr. James Stark discovered near Edinburgh a new species of the present genus, which greatly resembles the common species, but is rather smaller, and has four spines on the back. It is the *G. spinulosus* (Four-Spined Stickleback) of Yarrell and Jenyns.

A still smaller species—the Ten-Spined Stickleback (*G. pungitius*, Linn.)—is distinguished, as its English name implies, by the possession of ten spines on the back, and these are short and of equal length.

This, as well as the other species of the genus, is occasionally found in the salt-water. It appears to be pretty generally distributed throughout England.

Lastly may be noticed the Fifteen-Spined Stickleback (*G. spinachia*, Linn.), which is also found in England, a comparatively large species, being 5 or 6 inches in length, of an elongated and slender form, and having the snout much produced. The fifteen spines on the back are small and short; the fins are proportionally large.

This species appears to be confined to the salt-water, and feeds upon small *Crustacea*, as well as the eggs and fry of other fishes. It constitutes the sub-genus *Spinachia*, and is the *Spinachia vulgaris* of Fleming.

GASTRIC JUICE or ACID. [DIGESTION.]

GASTROBRANCHUS. [PETROMYZIDÆ.]

GASTROCHÆ'NA, a genus of Acephalous *Mollusca* belonging to the order *Lamellibranchiata*. It was established by Spengler. Lamarck places it between *Pholas* and *Solen*, and Cuvier between *Fistulana* and *Teredina*. M. Deshayes, in his edition of the 'Animaux sans Vertèbres,' says that it is evident that Lamarck came to very erroneous conclusions as to this genus. The animal, observes M. Deshayes, has two posterior very short siphons when it is contracted; the lobes of the mantle are united up to the gape of the valves and even a little higher; this gaping of the valves as well as the divarication of the lobes of the mantle, gives passage to a great short cylindrical foot, like that of the *Pholades*; but this opening is not at all destined for the passage of the siphons, as Lamarck supposed.

Mr. G. B. Sowerby ('Genera of Recent and Fossil Shells') remarks, that the genera *Pholas*, *Mya*, *Mytilus*, and *Chama*, have by turns served as a receptacle of the shells of this genus. He observes that Lamarck has adopted Spengler's name, but has placed it next to *Pholas*, apparently not having known that the animal forms its own testaceous tube, either as a lining to the hollow it has previously perforated, or as a covering for its shell in those instances in which it has not perforated at all, but in which it has taken up its abode, as it frequently does, within some spiral univalve. Mr. Sowerby is further of opinion, that the fact of the shell being inclosed in a testaceous tube of its own depositing, renders it proper to remove it into Lamarck's family of *Tubicolæ*, to which indeed it appears to Mr. Sowerby to be more nearly related, though he notices a very considerable analogy between the shelly tube of Lamarck's *Tubicolæ*, and the coriaceous epidermis, which not only in a great measure covers the shell, but also incloses the tubes of the animal of Lamarck's *Pholadaceæ*, and Mr. Sowerby consequently thinks that the two families might very properly be united.

Professor Owen, in his paper on *Clavagella*, remarks how closely that form follows the modifications which have been observed in *Gastrochæna*. [CLAVAGELLA.]

Cuvier says that it appears that the *Gastrochænæ* constantly have a calcareous tube, and quotes Dr. Turton, M. Deshayes, and M. Audouin, as having observed it.

M. Rang says that all the *Gastrochænæ* have not a calcareous tube, though all of them burrow in stones after the manner of *Pholades*. If this is to be taken literally, it does not exactly accord with the fact; for sometimes the animal does not burrow at all, at others (and very frequently) it burrows in madrepores. M. Rang adds that two of the species which belonged to the genus *Fistulana* of Lamarck are now arranged in this, and that this arrangement is due to M. de Blainville. These two species, he says, are *Fistulana clava* and *F. ampullaria*. Of these, *Fistulana clava* is referred among the synonyms to *Gastrochæna* by Lamarck, and *Fistulana ampullaria* is declared by M. Deshayes to be a true *Fistulana*, but remarkable in this, that, according to circumstances, it forms a free tube sunk in the sand, or perforates calcareous bodies, and its tube serves as a lining to the cavity which it inhabits; this species therefore, he observes, would belong to the *Fistulanæ* in the first case, and to the genus *Gastrochæna* in the second, if indeed that genus be preserved.

M. Rang states that M. Charles Des Moulins, who a long time ago, and before the observations made upon this subject, had discovered the existence of a tube in the *Gastrochænæ*, had shown him this tube, not only in the living species on the French coast, but in the fossil at Merignac. Following De Blainville, M. Rang would divide the genus *Gastrochæna* into the two following groups:—

α. Species whose shell is smooth and without a distinct tube.
Example, *Gastrochæna cuneiformis*, &c.

β. Species whose shell is striated from the umbo to the base, and contained in a distinct tube.
Example, *Gastrochæna clava*.

M. de Blainville states that the animal of *Gastrochæna* has evidently the greatest relationship to that of *Saxicava*; but as it is not entirely contained in its shell, it often supplies the deficiency by forming an artificial tube adhering to the walls of the cavity which it inhabits in calcareous stones.

This tube, in the opinion of M. de Blainville, offers only an accidental character, and would thus make of species, or even of individuals which are provided with it, *Fistulanæ* of Lamarck. Thus, he observes, M. Deshayes has proposed to suppress the genus *Gastrochæna*, but he would consider it more convenient not to admit the genus *Fistulana*; first, because it is founded upon the presence of a tube; and secondly, because it was established some time after *Gastrochæna*. He would however prefer its restriction as he has restricted it in his 'Malacologie.' In uniting the species characterised by the true shell, whether it have an external tube or not, there exist already, he remarks, many species of known *Gastrochænæ*, both living in the seas of warm climates and fossil in his country. M. Defrance, he states, nevertheless quotes one fossil species only at Grignon, and an analogue; and he concludes by observing that *Gastrochæna clava* would perhaps, if it were better known, form a small distinct genus.

Mr. G. B. Sowerby ('Zool. Proc.,' 1834) describes five new species brought home by Mr. Cuming from South America and the Gallapagos Islands and Lord Hood's Islands.

The following is M. Rang's definition of the genus:—

Animal oval, having the mantle closed with a very small anterior rounded opening for the passage of a small, conical, or linguiform foot: the tubes elongated and united throughout.

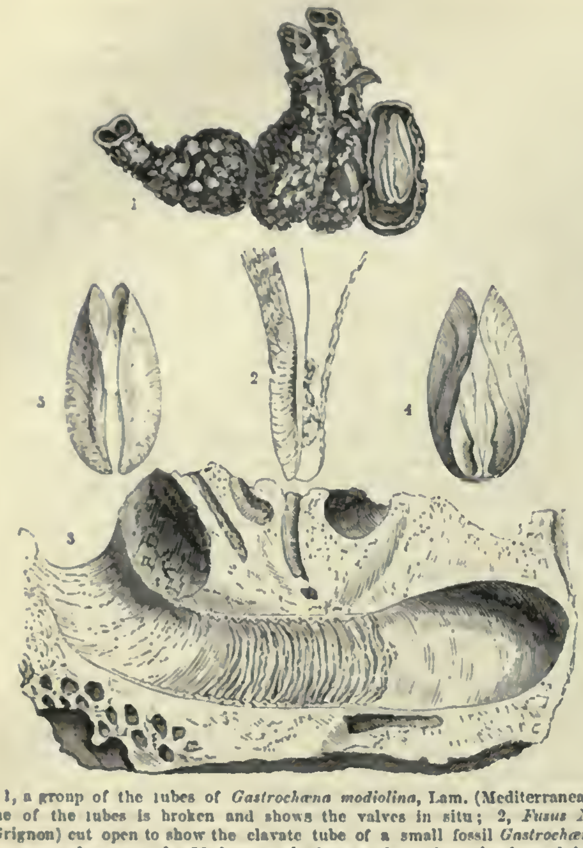
Shell delicate, oblique, oval, cuneiform, equivalve, very inequilateral, gaping extremely at its antero-inferior part; umbones well marked; hinge straight and linear, without teeth; an apophysis often showing itself below the hinge in the interior of each valve; ligament external; muscular impressions distinct, connected by a slightly marked pallial impression excavated posteriorly.

Sometimes a calcareous tube, ampulliform, short, with a rounded aperture, enveloping the shell and lining the cavity of the stone.

G. modiolina has been found on the English and Irish coasts. It is a common inhabitant of the Mediterranean.

Messrs. Forbes and Hanley adopt *Gastrochæna* as the type of a family, *Gastrochænidæ*, in which they include with M. Deshayes not only the genera *Aspergillum*, *Clavagella*, and *Gastrochæna*, but also *Saxicava*; and express the opinion that *Petricola*, and probably *Venerupis*, have strong claims to a similar position. The following is the definition given of this family in Forbes and Hanley's 'British Mollusca':—

"The animals of this amily are oblong or claviform, and often provided with very long siphons, united almost to their extremities, where their orifices are ornamented with cirrhi. The mantle is closed in front, except a small opening for the passage of a very small digitiform foot, very different from that of the *Pholas* tribe. The margin of the mantle around this opening is plain. The shell is equivalve, and often gaping, with valves often very inequilateral, united by a simple rudiment, or in some cases a toothed hinge, often variable, even in the species of a single genus. They have no spoon-shaped apophysis under the beaks, nor accessory plates behind them. A calcareous tube sometimes protects the valves, and in certain genera



1, a group of the tubes of *Gastrochæna modiolina*, Lam. (Mediterranean); one of the tubes is broken and shows the valves in situ; 2, *Fusus Noæ* (Grignon) cut open to show the clavate tube of a small fossil *Gastrochæna*; 3, a worn fragment of a Madrepore, broken to show the tube formed by a specimen of *Gastrochæna cuneiformis*, Lam.; 4 and 5, two views of the two valves of the last-mentioned species. (From the 'Genera of Recent and Fossil Shells,' by G. B. Sowerby.)

unites with them. These tubes are very regular and curious in some of the exotic species, especially in those which live buried in sand. This habit is not merely the living habitually and freely in sand, as the Razor-Fish do, but rather the treating of it in the manner of a substance bored into; and the tubes are to be regarded as the linings of the perforations so made. All the species of the family are borers, most of them preferring calcareous rock."

For an account of *Saxicava* see LITHOPHAGIDÆ.

GASTROCHÆNIDÆ. [GASTROCHÆNA.]

GASTROMARGAS. [QUADRUMANA.]

GAULT. [CHALK FORMATION.]

GAULTHERIA, a genus of Plants belonging to the natural order *Ericaceæ*. It has a 5-cleft or 5-toothed calyx, bibracteate at the base, after flowering becoming large and succulent, and covering the capsule with a baccate coating. The corolla is ovate, ventricose, with a 5-cleft revolute border, transparent at the base. There are 10 stamens, inclosed, with flat filaments; anthers bifid at the apex; lobes biaristate. The hypogynous scales 10, usually united at the base. The ovarium half inferior. The capsule 5-celled, with a loculicidal dehiscence.

G. procumbens, Partridge-Berry, Chequer-Berry, Boxberry, Mountain-Tea, is found on sterile sand and gravel in mountainous forests in the driest situations in North America. It has a horizontal woody rhizoma, often a quarter of an inch in thickness. The branches are ascending, but a few inches high, round and somewhat downy. The leaves are scattered near the extremities of the branches, evergreen, coriaceous, shining, oval or obovate, acute at both ends, revolute at the edge, and furnished with a few small serratures, each terminating in a bristle. The flowers are axillary, drooping, on round downy stalks. There are two concave heart-shaped bracts. The calyx is white, cleft into 5 roundish acute segments. The corolla is white, urceolate, 5-angled, contracted at the mouth, the limb divided into 5 short reflexed segments. The filaments white, hairy, bent in a semicircular manner to accomodate themselves to the cavity between the corolla and ovary. The anthers oblong, orange-coloured, ending in two double horns, bursting outwardly for their whole length. Above the filaments the pollen white. The ovary is roundish, depressed, 5-angled, resting on a reddish 10-toothed glandular disc; the style erect, straight; the stigma simple. The fruit is a small 5-celled many-seeded capsule, invested with the calyx, which becomes large, round, and fleshy, having the appearance of a bright scarlet berry. The fruit contains an aromatic sweet highly pungent volatile oil, which is antispasmodic and diuretic. A tincture has been useful in diarrhœa. Cox states that the infusion is useful in asthma. It is used in North America as tea, and brandy in which the fruit has been steeped is taken in small quantities, in the same way as common bitters. The oil is known under the name of Oil of Wintergreen, and is used by druggists to flavour syrups, and also by perfumers.

G. Shallon is a native of North America on the falls of the Columbia, and near the Western Ocean. It has a procumbent hairy stem, ovate subcordate serrated leaves, glabrous on both surfaces, the racemes secund bracteate, clothed with rusty down. The corolla is white tinged with red, downy, urceolate, with a closed limb. The berries are globose, acute, fleshy, and purple. This plant grows in the shade of close pine-forests where hardly anything else will grow, which makes it a very desirable shrub for plantations. The berries are much esteemed by the natives on account of their agreeable flavour.

G. hispida, Wax-Cluster, is a native of Van Diemen's Land; it has long lanceolate serrulated leaves, piloso beneath as well as on the petioles; the branchlets hispid; racemes axillary and terminal, shorter than the leaves; the rachis and pedicels downy; the calyxes baccate, fruit and ovaries glabrous, the stem erect. It bears snow-white berries, with a flavour by no means unpleasant; in taste it is said to resemble the gooseberry, but is somewhat bitter. According to some *G. antipoda* is said to have more merit as a fruit.

The species are all ornamental, and grow best in a peat soil.

(Lindley, *Flora Medica*; Lindley, *Vegetable Kingdom*; Don, *Dichlamydeous Plants*.)

GAVIAL. [CROCODILIDÆ.]

GAYAL. [BOVIDÆ.]

GAY-LUSSITE, a Mineral, occurring in oblong crystals in a lake in Maricaibo, South America. It is a hydrous compound of the carbonates of lime and soda. (Dana, *Mineralogy*.)

GAZELLE. [ANTILOPEÆ.]

GEBIA. [THALASSINIANS.]

GECARCI'NUS (Leach), the name of a genus of Brachyurous Decapod *Crustacea*, known familiarly to the English as Land-Crabs, and to the French by the appellations of Tourlouroux, Crabes Peintes, or Crabes Violets, some of these terms being applicable not only to different species, but to the same species at different ages, so that those various names cannot be depended upon as specific designations.

Latreille placed this tribe of crabs immediately after Pinnothères. He seems to admit *Plagusia* and *Grapsus* into the same section with the Land-Crabs, properly so called; and next to *Grapsus* come the *Orbiculata* (his fourth section), containing *Corystes*, &c.

Desmarest places *Gecarcinus* at the head of the Quadrilatères of Latreille, and arranges all the true Land-Crabs under that generic title, which is preceded by *Pilumnus*, and succeeded by the *Orbiculata* of Latreille.

M. Milne-Edwards makes the Gecarcinians the second tribe of his family of Catametopes; and in his arrangement they stand between the Thelpusians, the first tribe, and the Pinnotherians, the second tribe of that family.

According to the last-named author the tribe of Gecarcinians is one of the most remarkable groups of the class *Crustacea*; for it is composed of animals breathing by means of branchiæ, or gills, and yet essentially terrestrial, so much so indeed, that they would perish from asphyxia if submerged for any length of time. They may be distinguished easily from the rest of the family by their nearly oval carapace, which is much elevated and convex above. The branchial regions are in general very distinct, and project much below, occupying nearly two-thirds of the surface. The front is very nearly as large as the buccal frame (cadre buccal), and strongly curved below. The orbits are suboval, moderate, and very deep. The lateral borders of the carapace are very much arched, and generally describe a semicircle. The internal antennæ are lodged under the front, and fold back transversely in narrow and often nearly linear excavations. The disposition of the external antennæ varies, and so do the jaw-feet (pates-mâchoires); sometimes the fourth joint is inserted at the external angle of the preceding, and remains exposed, as in the Ocypodians, and sometimes it is entirely hidden under its internal surface. The feet of the first pair are long and strong; the succeeding feet are robust and long, and very nearly equal in size, and their tarsus is pointed and quadrilateral. The abdomen of the male is received in a deep excavation of the sternal plastron, and its second articulation reaches nearly always to the base of the posterior feet. It is in general so long that it comes up to the base of the mouth, and the appendages hidden beneath it are remarkably large. The branchiæ are generally seven in number, namely, five fixed to the vault of the sides, and two, in a rudimentary state, hidden under the base of the preceding, and taking their origin from the jaw-feet; but in some species there are nine on each side. The respiratory cavity is very large, and is raised into a vault highly elevated above the branchiæ, so that above those organs there is a large empty space. The tegumentary membrane with which it is lined is also very spongy, and sometimes forms a fold along the lower edge of the cavity, so as to form a kind of gutter, or longitudinal trough for containing water when the animal remains exposed to the air. (Milne-Edwards.) Observations on this curious reservoir were communicated to the Royal Academy of Sciences in France by Messrs.

Audouin and Milne-Edwards some years ago, wherein the authors show that in all the *Crustacea* the branchiæ are fitted to perform the functions of respiratory organs in the air as well as in the water; that the more or less rapid death of the aquatic species, when exposed to the air, depends upon various causes, of which one of the most direct is the evaporation from the branchiæ, which produces their desiccation; that consequently one of the conditions necessary to the support of life in animals which have branchiæ, and live in the air, is the having these organs defended against desiccation; and lastly, that these dispositions actually occur in the Land-Crabs, which all possess various organs destined for absorbing and keeping in reserve the quantity of moisture necessary for maintaining a suitable degree of moisture in the branchiæ. [CRUSTACEA.]

The Land-Crabs, or Gecarcinians, inhabit the warm countries of the New and Old World, and Australasia; but as far as observation has hitherto gone, America and its islands seem to be the places where the form is most highly and most numerously developed. Almost every writer on the Natural History of the countries last mentioned treats largely on the habits of these creatures; and in the works of Rochefort ('Histoire Naturelle des Antilles'), De Feuillée ('Observations faites sur les Côtes d'Amerique'), De Labat ('Nouveau Voyage aux Isles d'Amerique'), Sloane ('Natural History of Jamaica'), Browne ('Civil and Natural History of Jamaica'), Hughes ('Natural History of Barbadoes), Catesby ('Natural History of Carolina'), &c., &c., will be found details more or less ample, and highly interesting, of their manners; though most of the writers do not determine the species sufficiently to enable us to judge of what particular Land-Crab they are writing. All these authors will however well repay the trouble of consulting them.

Latreille sums up what he considers the credible parts of these narratives thus:—"The crabs pass the greatest part of their life on land, hiding themselves in holes, and not coming forth till evening. Some keep about cemeteries. Once a year, when they would lay their eggs, they assemble in numerous bands, and move in the shortest direction to the sea, without caring for any obstacles. After they have finished their deposit they return much weakened. It is said that they block up their burrows during their moult; and while they are undergoing this operation, and are still soft, they are called Boursiers (Purse-Crabs) [BIRGUS], and their flesh is then much esteemed, although it is sometimes poisonous. This quality is attributed to the fruit of the manchineel, of which the people think, falsely perhaps, that the crabs have eaten."

With regard to the alleged want of foundation for the story of the Land-Crabs being sometimes poisonous, in consequence of what they have eaten, there are so many testimonies to the fact, that it will be a fault on the right side to be cautious. Thus Sloane, who praises (as who does not?) their delicacy of taste, says:—"They are thought to be poysonous when they feed on the Mansanilla-tree leaves or fruit, which I suppose may come from some of it sticking to their chaps, or lying undigested in their stomachs, which are not separated before eating." Catesby writes:—"Some are black, some yellow, some red, and others variegated with red, white, and yellow mixed. Some of these, as well as of the fish of this country, are poisonous; of which several people have died, particularly of the black kind: the light-coloured are reckoned best, and when full in flesh are very well tasted. In some of the sugar islands they are eat without danger, and are no small help to the negro slaves, who on many of the islands would fare very ill without them. They feed on vegetables." Hughes, speaking of the 'large white land-crab,' and its feeding on grass, &c., remarks: "They likewise often feed upon manchineel apples, as well as upon the leaves or berries of poison-trees. At such times they are dangerous to be eaten, unless very great care be taken to wash the fat, as well as the other meat on the inside, with lime-juice and water." He says the same in effect of 'the Mulatto Crab.'

M. Milne-Edwards thus gives his summary:—"The greater number ordinarily haunt humid places, and hide themselves in holes which they excavate in the earth, but the localities preferred by them vary with the species. Some live in the low and marshy lands near the sea, others on the wooded hills far from the shore; and at certain epochs, these last quit their habitual dwelling to go to the sea. It is even reported that then these Crustaceans unite in great bands, and thus make very long journeys without suffering themselves to be stopped by any obstacle, and laying waste everything in their route. Their principal food consists of vegetable substances, and they are nocturnal or crepuscular in their habits. It is more particularly in the rainy season that they quit their burrows, and they run with great rapidity. It would appear that it is at the time of laying that they go to the sea and there deposit their eggs, but we know of no decidedly positive observation on this point. During their moult they remain hidden in their burrows." ('Hist. Nat. des Crustacés.')

We select Browne's account of the Black or Mountain Crab (*Cancer ruricola*, Linn.), because he resided many years in the island of Jamaica, and seems to have lost no opportunity of making personal observations:—"These creatures are very numerous in some parts of Jamaica, as well as in the neighbouring islands, and on the coast of the main continent. They are generally of a dark purple colour, but this often varies, and you frequently find them spotted, or entirely of another hue. They live chiefly on dry land, and at a considerable distance from the sea, which however they visit once a year to wash off their spawn, and afterwards return to the woods and higher lands, where they continue for the remaining part of the season; nor do the young ones ever fail to follow them as soon as they are able to crawl. The old crabs generally regain their habitations in the mountains, which are seldom within less than a mile, and not often above three miles from the shore, by the latter end of June, and then provide themselves with convenient burrows, in which they pass the greatest part of the day, going out only at night to feed. In December and January they begin to be in spawn, and are then very fat and delicate, but continue to grow richer until the month of May, which is the season for them to wash off their eggs. They begin to move down in February, and are very much abroad in March and April, which seems to be the time for the impregnation of their eggs, being then frequently found fixed together; but the males about this time begin to lose their flavour and the richness of their juices. The eggs are discharged from the body through two small round holes situated at the sides, and about the middle of the under shell: these are only large enough to admit one at a time; and as they pass they are entangled in the branched capillaments, with which the under side of the apron is copiously supplied, to which they stick by the means of their proper gluten, until the creatures reach the surf, where they wash them all off, and then they begin to return back again to the mountains. It is remarkable that the bag or stomach of this creature changes its juices with the state of the body; and while poor is full of a black, bitter, disagreeable fluid, which diminishes as it fattens, and at length acquires a delicate rich flavour. About the month of July or August the crabs fatten again, and prepare for mouldering, filling up their burrows with dry grass, leaves, and abundance of other materials: when the proper period comes each retires to his hole, shuts up the passage, and remains quite inactive until he gets rid of his old shell and is fully provided with a new one. How long they continue in this state is uncertain; but the shell is observed to burst both at the back and sides to give a passage to the body, and it extracts its limbs from all the other parts gradually afterward. At this time the fish is in the richest state, and covered only with a tender membranous skin, variegated with a multitude of reddish veins, but this hardens gradually after, and becomes soon a perfect shell like the former: it is however remarkable that during this change there are some stony concretions always formed in the bag, which waste and dissolve gradually as the creature forms and perfects its new crust. A wonderful mechanism! This crab runs very fast, and always endeavours to get into some hole or crevice on the approach of danger; nor does it wholly depend on its art and swiftness, for while it retreats it keeps both claws expanded, ready to catch the offender if he should come within its reach, and if it succeeds on these occasions it commonly throws off the claw, which continues to squeeze with incredible force for near a minute after; while he, regardless of the loss, endeavours to make his escape and to gain a more secure or a more lonely covert, contented to renew his limb with his coat at the ensuing change; nor would it grudge to lose many of the others to preserve the trunk entire, though each comes off with more labour and reluctance as their numbers lessen."

Thus much of the habits of the Land-Crabs of the New World. The late Bishop Heber, in his 'Narrative' gives an account of some Land-Crabs in India, living at a great distance from the sea, and obstructed by great obstacles in their passage to it. "The plain of Poonah," writes the bishop, "is very bare of trees, and though there are some gardens immediately around the city, yet as both these and the city itself lie in a small hollow on the banks of the river Moola, they are not sufficiently conspicuous to interrupt the general character of nakedness in the picture, any more than the few young trees and ornamented shrubs with which the bungalows of the cantonment are intermingled. The principal and most pleasing feature is a small insulated hill immediately over the town, with a temple of the goddess Parvati on its summit, and a large tank (which, when I saw it, was nearly dry) at its base. All the grass-land round this tank, and generally through the Deckan, swarms with a small land-crab, which burrows in the ground, and runs with considerable swiftness, even when encumbered with a bundle of food almost as big as itself. This food is grass, or the green stalks of rice, and it is amusing to see them sitting as it were upright, to cut their hay with their sharp pincers, then waddling off with the sheaf to their holes as quickly as their sidelong pace will carry them." Upon this passage Mr. Broderip observes, that when we call to mind the position of Poonah, and read of the neighbouring river and tank, we may feel inclined to ask whether the river or the tank might not be the scene of ovipositing; and, he adds, that it is not improbable that there may be a race of land-crabs appropriated to continental or even insular situations out of reach of the ocean, and that fresh water may be as necessary to their reproduction as sea-water is to the land-crabs of the West Indies. Such a supposition, he thinks, is in unison with the bountiful provisions of nature for the general diffusion of animal life. ('Zool. Journal,' vol. iv.)

Mr. Westwood in his interesting paper 'On the supposed Existence of Metamorphoses in the Crustacea' ('Phil. Trans.,' 1835), notices the abdomens of several female crabs having the interior surface covered with hundreds of eggs or newly-hatched young, which were in the collection of the late Rev. Landsdown Guilding. One of the bottles in which one of these was deposited was labelled by the last-mentioned gentleman, 'Eggs and Young of a Land-Crab not undergoing Metamorphosis.' From this specimen Mr. Westwood obtained eggs, and young crabs evidently just hatched, and others at a rather later stage of their growth. The eggs were of a dark reddish colour, showing through the outer integument the rudimental limbs of a future animal of a paler colour. On removing the thin transparent pellicle which surrounded one of these eggs, the eyes were most conspicuous, the tail was seen extended as a narrow plate, nearly reaching to the eyes, and along its sides lay the large anterior cheliferous and the four following simple pairs of limbs. The existing organs, although perfectly discernible, occupied only a small portion of one side of the egg, its greater part being filled with hardened matter composed of minute molecular grains. The animal was in a sufficiently forward state of development not to allow the least doubt to be entertained as to the nature of these limbs, nor did any organs appear answering to the two large split pairs of natatory organs of *Zoëa*. The branchiæ, in a fleshy and unorganised state, were also found at the base of the legs. The eggs were $1\frac{1}{4}$ lines in diameter.

Mr. Westwood gives in his 'Memoir' figures of the egg, and of the young crab in progressive stages of growth.

As an article of food some of the Land-Crabs, when in season and well nourished, may be considered as combining the qualities of wholesomeness and delicious flavour. We have conversed with men of various tastes who have partaken of this luxurious food, and all agree in describing it as exquisite. Indeed it appears that when simply cooked in its own juices, in its own shell, it requires no condiment but a squeeze of the fragrant lime to make it one of the best of dishes. "When the Black Crab (*Gecarcinus ruricola*) is fat," says Dr. Patrick Browne, "and in a perfect state, it surpasses everything of the sort in flavour and delicacy; and frequently joins a little of the bitter with its native richness, which renders it not only more agreeable in general, but makes it sit extremely easy upon the stomach. They are frequently boiled and served up whole; but are commonly stewed when served up at the more sumptuous tables." Land-Crabs have been brought alive to this country, and have been exhibited in the Zoological Gardens in the Regent's Park, London. The question has been asked why are not these crabs imported for our tables as regularly as turtle? Barrels with grass and other vegetables, such as they are generally kept in, when there is no better convenience, in their native country, would not take much room on the deck of vessels; and if the crabs were collected at the proper time and allowed sufficient moisture, and only sufficient to keep them in health, an ordinary voyage would bring them to us, most probably, in very fair condition.

M. Milne-Edwards separates the Gecarcinians into the following genera:—

Uça (Latreille).—Carapace much wider than it is long, of a suboval shape, and very much elevated; front narrower than in the other Gecarcinians, very much inclined, and nearly semicircular; orbits rather large, and open externally below their external angle; anterior fossettes suboval, small, and separated by a small triangular prolongation from the epistome; the external antenna occupies the orbitary internal canthus; the buccal frame is of a rhomboidal form; the second and third joint of the external jaw-feet are quadrilateral, nearly of the same size, and terminate on the internal side by a straight border; the fourth joint is inserted at the external angle of the preceding, and is applied against its anterior border; the feet present nothing particular, except that the pincers are a little widened at the end and slightly spoon-shaped, and that the tarsi are flattened, not spinous, and nearly of the same form as in *Ocypode*; thoracic branchiæ five; the membrane which lines the vault of the branchial cavity is folded below and within, so as to form at its lower part a sort of gutter or trough. (Milne-Edwards.)

(*Uça una.*)

Uça una (Marcgrave).—M. Milne-Edwards considers this to be the *Cancer Uça* and *Cancer cordatus* of Linnæus, *Cancer cordatus* of Herbst, *Ocypode cordata* of Latreille ('Hist. Nat. des Crust. et Ins.'), and *Uça una* of the same author ('Encyc. Method.'), and *Gecarcinus Uça* of Lamarck. He observes that M. Latreille cites his *Ocypode fossor* as one of the synonyms of *Uça una*, but that he (M. Milne-Edwards) is inclined to believe that it is rather referrible to *Uça lævis*.

The lateral edges of the carapace in this species are furnished with a small projecting and finely-dentilated crest. Pterygostomian regions very granulous. Manus spiny above and within. Feet hairy below, moderate in length; the third pair rather longer than the others. Size, 2 inches (French). The *Uça una* is a native of South America.

Cardisoma (Latreille).—Carapace more elevated and square than in the greater part of the same tribe. Buccal frame in the shape of a long squared figure, with its lateral edges straight. The second joint of the external jaw-feet narrowed anteriorly, and the third, which is a little shorter than the preceding, widening from behind forwards, so that these organs leave between them, in the middle of the buccal apparatus, a wide space with nearly the form of a lozenge; the third joint, which is nearly cordiform, is notched on its anterior border, and gives insertion at its external angle to the fourth joint, which like the succeeding ones always remains exposed. Front very large and nearly straight. Antennary fossettes transversal, and separated by a semicircular and very wide surface. Feet of the third and fourth pairs longest; the tarsi quadrilateral and very spiny. Branchiæ placed under the vault of the sides, seven on each side, the first being ordinarily very small and the last two very long.

The species of this genus live in the woods, and dig deep and oblique holes, whence they come not forth except at night. (Milne-Edwards.)

C. Carnifex. This, according to M. Milne-Edwards, is the *Cancer Carnifex* of Herbst; *Ocypode cordata*, *Gecarcinus Carnifex*, and *Cardisoma Carnifex* of Latreille; and he cites also *Gecarcinus hirtipes* of Lamarck, as a synonym, but with a query.—Carapace very much elevated, and its surface very much curved from before backwards, but nearly horizontal transversely: its lateral edges marked by a projecting and elevated line. A small tooth behind the external orbitary angle. Four rows of spines upon the tarsi; the two lower not numerous. Pincers large on one side. Manus very large. Fingers touching nearly throughout their length. Length, 2 inches (French). (Milne-Edwards.)

It is found in the neighbourhood of Pondicherry.

Cardisoma Carnifex.

Cancer Hydromus of Herbst, in the opinion of M. Milne-Edwards, is evidently a species approximating closely to the preceding, if indeed it can be distinguished from it.

Cardisoma Guanhumi, which inhabits the Antilles, is more than three inches in length, and the claws of the male are larger than the body, very much curved, and not touching except at their extremity.

Gecarcoïdea.—Carapace more oval and less elevated than in the preceding genera. Front of moderate length, straight, and very much inclined. Antennary fossettes rounded, and separated by a small triangular prolongation of the front. Orbits small; their inferior border much less projecting than in the preceding genera, and leaving between its internal angle and the external antenna a large and deep notch. Buccal frame not so clearly circumscribed as ordinarily, and rather circular than square. External jaw-feet with a wide space between them; their third joint much less than the second, nearly quadrilateral, little or not at all narrowed backwards, and deeply notched at its anterior edge, at the middle of which is inserted the succeeding joint, which is exposed.

G. Lalandii. Carapace inclining to oval, and without a crest on its lateral edges. Feet strong; pincers large, cylindrical, tuberculous, and touching throughout their length; anterior edge of the arms nodulous; succeeding feet dentilated on the edges, those of the third pair the longest. Six rows of dentations on the tarsi. Colour brownish-red. Length rather more than three inches. (Milne-Edwards.)

It is found in Brazil.

Gecarcinus.—Carapace not much elevated, but very convex on the sides. Front very strongly curved below. Orbits deep, inclining to oval, and without a notch on the external side. Internal antennæ nearly hidden under the front, which has a small prolongation that goes to join the epistome. The disposition of the external antennæ and that of the canthus of the orbit nearly the same as in the preceding genus. Buccal frame nearly circular, and not clearly separated from the pterygostomian regions. External jaw-feet very wide, but with a space between them; their second joint completely covers the succeeding joints, which are inserted on its internal surface. The external appendage of these organs is hidden under their second joint, and its extremity scarcely overpasses it. Feet presenting nothing remarkable, excepting that their edges are armed with spiniform teeth.

It is an inhabitant of the Antilles and Australasia.

G. ruricola; Cancer terrestris, Seba; *Cancer ruricola*, Linnæus; the Land-Crab, Sloane; the Black or Mountain-Crab, Browne; Crabe Violet (?), Labat. Tarsi armed with six rows of spiniform teeth. Internal edge of the third joint of the jaw-feet without any remarkable fissure. Carapace very large. A few teeth on the internal edge of the carpus. Length rather more than three inches. Colour purplish or reddish-violet, or yellow washed with red. (Milne-Edwards.)

It is found in the Antilles.

Land-Crab (*Gecarcinus ruricola*).

Fossil Gecarcinians.—M. Desmarest, in his 'Histoire Naturelle des Crustacés Fossiles,' describes and figures a species which he notices as being sufficiently common in collections under the name of *Gecarcinus trispinosus.* The same author, in his 'Considérations Générales sur la Classe des Crustacés,' alludes to this figure and description; and observes that he has arranged the fossil, with doubt, under the genus *Gecarcinus.* M. Milne-Edwards ('Histoire Naturelle des Crustacés') expresses his belief that this fossil is not a Gecarcinian; and says that it would appear, from the form of the carapace, to approximate more to the genus *Pseudograpsus.*

GECKO'TIDÆ, a natural family of Saurian Reptiles, belonging to Gray's sub-order *Pachyglossa*, and the tribe *Nyctisaura.*

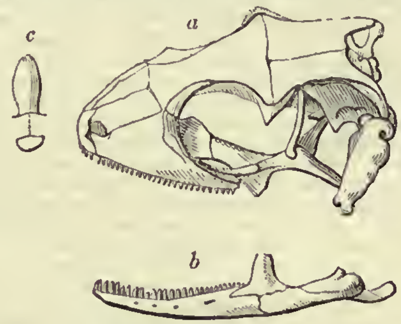
Their head is wide and flattened, with the mouth wide; the nostrils are distinct and lateral; the eyes large, hardly surrounded by short lids, the lower edge of which in the greater number of species does not project outwards, the pupil sometimes rounded, but most frequently dentilated, linear, and lightly fringed; and the auditory opening bordered with two folds of the skin. The teeth are small, equal, compressed, sharp at the point, entire, and planted in the internal edge of the jaws: there are none on the palate. The tongue is short, fleshy, capable of but little elongation, and free at its extremity, which is either rounded or flattened, or very slightly notched.

Their neck is apparently little, in consequence of the width of the back part of the head and the squareness of the shoulders. Their body is thick and short, depressed, and low on the legs, with a belly flat below, dragging on the ground, and largest in the middle. There is no crest on the back. The tail varies, but is not long, and often has folds or circular depressions, but never a dorsal crest.

The feet are short, nearly equal in length, wide apart, and robust; the toes nearly equally long, most frequently flattened below, widened, and furnished with transverse imbricated plates; the nails vary, but they are ordinarily hooked, sharp, and retractile. The conformation of the feet enables the Geckos to run with ease on the smoothest surfaces in every direction, or to remain stationary on them with the back downwards, after the manner of a common house-fly.

The skin is defended by equal granular scales, most frequently interspersed with other tubercular scales, the points blunt or angular. There are femoral pores, or pores in front of the vent, on the same line in the majority of species, and most frequently in the males only. The limbs and sides are sometimes bordered with fringed membranes.

Skeleton.—The skull of the *Geckotidæ* is marked by some peculiar characters. The bones are well defined, nor do the sutures seem to be obliterated by age. In general contour it approaches the skull of the *Crocodilidæ* by its width, its flatness, and its length; its particular resemblances to the same part in that family are to be found in the disposition of the orbits and in the articulation of the jaws. The excavations for the eyes are very large and apparently incomplete, inasmuch as the orbital frame is not entirely bony in its back part, nor has it, so to speak, any flooring, so that when deprived of the softer parts the cavity communicates with the mouth. The articulation of the jaw is quite backwards, and the os quadratum or interarticular bone is wide, short, and hollowed on its posterior surface, for the purpose of receiving the muscle, whose office it is to open the jaws and keep them open. The skull differs from that of the other lizards generally in the extreme smallness of the jugal and temporal bones, and in having the parietal bones divided longitudinally into two.



Skull of a species of *Gecko.*
a, cranium; *b*, lower jaw; *c*, a tooth enlarged. (Cuv., 'Oss. Foss.')

The vertebræ vary in number, and, according to Meckel, their body is hollowed into two conical cavities, very nearly like those of fishes: the spinal column is without any spinous processes or projections. The first three or four cervical vertebræ only are without false ribs or transverse articulated apophyses. These are gradually developed, and go on increasing in length and curvature to the fifth or seventh, but none of them are actually joined to the great anterior portion of the sternum. Those which follow reach and are articulated with that bone. They are succeeded by the free or abdominal ribs, which nearly equal in number the vertebræ which precede the pelvis, at least in the Banded Gecko.

The sternum in the Common Gecko (*Platydactylus guttatus* of Cuvier; *Gecko verus* of Merrem and Gray), consists of a very solid plate, which receives anteriorly and laterally in two angular notches the coracoid bones, which are wide and delicate, and the clavicles, which are narrow, elongated, and flattened, more especially at their sternal extremity. The rhomboid and backward portion of this sternal plate affords attachment on the two posterior facings to three pairs of ribs. From the posterior or abdominal angle of this bone two small parallel bones or sternal prolongations are given off, along which three other pairs of ribs are affixed by ligaments. After these six pairs of sternal ribs come seven other pairs, which are curved at their free or abdominal extremity into an obtuse angle, so that they are at this end directed forwards without any junction to a mesial line, as in the Chameleons. M. Duméril says that generally he has only counted 17 ribs, but he observes that there are 24 in the Banded Gecko (*Platydactylus vittatus* of Cuvier; *Gecko vittatus* of authors). Hence M. Duméril concludes that the number of ribs varies according to the species.

The caudal and pelvic vertebræ require notice. The articulation of the former is either weak, or the body of the vertebra itself is apt to break in the middle, so that a slight effort separates them, and many individuals consequently lose their tails. When these are regenerated, cartilage is generally found in the place of the former bone, and the tail then presents a variety of forms.

The bones of the limbs do not differ from those of the other Saurians so as to require any particular description, with the exception of those of the feet, and there the difference is striking with relation to the greater portion of the class. In the *Geckotidæ* the bones of the feet are so disposed as to receive the five toes of equal or nearly equal length, and which radiate as it were from a centre so as to form a nearly complete circle; for the external or great toe cannot separate itself from the others to extend itself backwards. The toes are not always furnished with nails; but they are often provided with very remarkable ones, which by their mobility and retractility remind the observer of the organisation of the same parts in the Cats (*Felidæ*).

Muscular System.—The muscles of the *Geckotidæ* are highly irritable, as might be expected in such nimble creatures. Their power of adhering to smooth surfaces makes it necessary that the resistance produced by the adhesion should be instantaneously overcome in case of danger; and we accordingly find that a Gecko which at one moment is fixed motionless to a spot, vanishes as it were in the next from under the hand stretched forth to capture it.

The brain and nervous system are considerably developed in the *Geckotidæ*, and the greater part of the senses are acute.

Sight.—The orbits, as we have seen, are large and without any flooring or base, and as the eye in this family is very large in proportion to the size of the animal, the projection of the posterior part of the globe may be seen in the inside of the mouth much in the same way as is observable in some fishes. There is scarcely any lid, and what there is is so small that an additional appearance of prominence is given to the eyeball. This lid is simple, circular, and adherent to the globe of the eye by an internal fold. There is a nictitating membrane. Most persons have seen that an epidermic scale which seems to be the external layer of the cornea comes off in serpents with the rest of the skin, and in the Geckos also the integument passes over the front of the eyeball. The eye in such animals never appears humid. M. Jules Cloquet has shown that in the serpents the tears probably are diffused between the epidermic scale and cornea in order to arrive at the nostrils. The pupil is sometimes rounded, but most frequently presents a linear slit, the edges of which are fringed, so that the animal can at its pleasure dilate or diminish the opening through which the light and the images are to be admitted to the retina. Like the Cats therefore, the Geckos, though said to be nocturnal in their habits, can also see perfectly well in broad daylight.

Hearing.—The auditory apertures in this family are sometimes in the form of slits, sometimes in that of oval or circular holes, and the edges are often rounded and sometimes dentilated. Wagler states that these apertures can be closed in *Ptyodactylus* and *Spheriodactylus*, and it is extremely probable that the rims have a power of approximation generally. The tympanum lies deep, and the auditory cavity communicates with the back of the mouth or throat for the admission of air, as in most pulmoniferous animals. M. Duméril says, that he has proved the sensibility of these animals to the least noises, and that their sense of hearing is very fine.

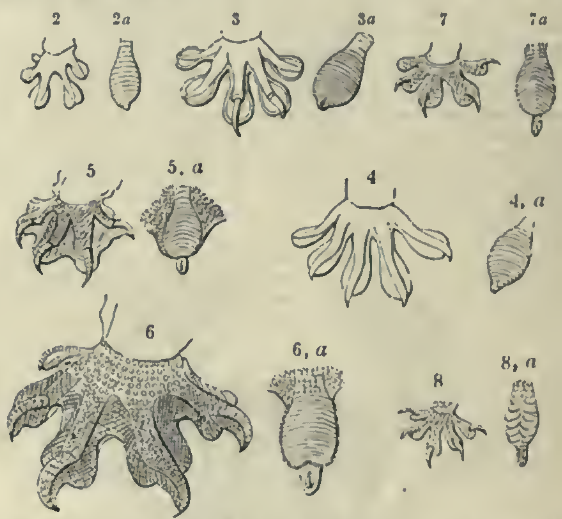
Smell.—The structure of the nostrils in this family would not lead to the conclusion that their sense of smelling is very acute, though it is probably more highly developed than it is in the Frogs.

Taste.—The *Geckotidæ* swallow their prey living, or nearly so, and almost entire, but the presence and form of the teeth render it probable that they can masticate; and this power, combined as it is with the form and structure of the tongue, which is soft, moveable, very fleshy, and furnished with papillæ, seems to indicate a certain degree of the sense of taste.

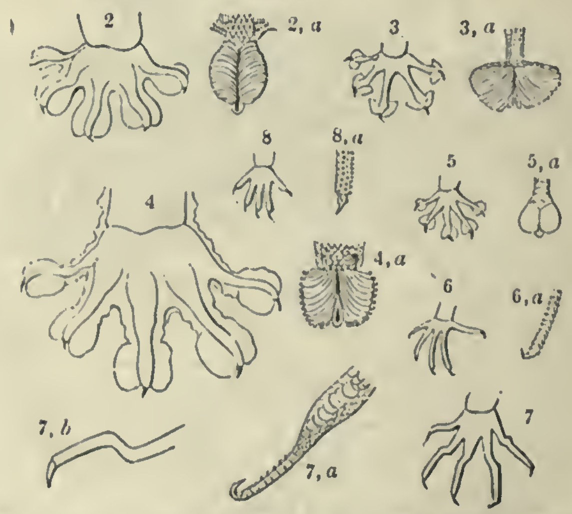
Touch and Integuments.—The skin of the Geckos is generally delicate, and adheres but little to the muscles, from which it is easily detached. In the middle of the back, and sometimes on the sides, granular tubercles rounded on their edges, with others which project at the centre, and are even fashioned into facets, are to be detected in the greater number. When the skin is detached and held up to the light it is seen to be regularly furnished with small delicate rounded escutcheon-like bodies, set in the thickness of the skin. The form and distribution of these bodies vary according to the different species in the regions of the belly, of the neck, of the thighs, of the head, and of the tail. M. Duméril, who gives us this information, goes on to state that generally the skin of the *Geckotidæ* is gray or yellowish, but that there are species in which lively colours are disposed on some parts of their bodies, and that it is even said that tints of red, blue, and yellow may be distinguished, which the animal causes to appear and disappear nearly after the manner of the chameleons. Some travellers assured Wagler that certain Indian Geckos became luminous or phosphorescent during the night.

In some of the species the skin is prolonged on the sides of the body and tail into membranes regularly festooned or fringed, and the Geckos generally moult or change their skins at certain periods of the year, when their colours, as is usual in such cases, become brighter. M. Duméril says that he has himself observed this in living individuals captured in their wild state at Cordova, in Spain, in the middle of the summer. There can be little doubt that there is considerable sensibility where the skin is constructed as it is in the Geckos; but in considering the sense of touch, the curious organisation of the feet and toes demands our particular attention. These are the great organs of station or fixation and progression, and the manner in which they perform their office is very interesting. M. Duméril, after referring to Wagler's reflections on this subject in his remarks on the *Platyglossi*, gives his own observations on this part of the organisation of the Geckos. He refers to the comparative shortness and general structure of the feet above given, and then proceeds to notice the particular conformation of the toes in the greatest number of species. The lower surface of these, and the sole, are very much dilated, widened, and furnished with small plates or lamellæ, following or overlying each other (lamelles placées en recouvrement) in a regular manner, but in a mode which varies in the different species. The nails, which are sometimes wanting on all the toes, are most frequently pointed, hooked, and more or less retractile, constituting a sort of claws, which remain constantly sharp. The toes are sometimes united at their base, and, as it were, semipalmated. In some of the species, *Ptyodactylus* and *Spheriodactylus* of Cuvier, for instance, the extremity of the toes expands, and widens considerably in form of a fan or semi-disc, as in the Tree-Frogs.

The membranous and soft plates with which the lower surface of the toes of the Geckos are furnished present a variety of modifications in the different genera. Sometimes they are simple, or continued from one edge to the other, and those of this class offer distinctions in the furrows themselves, and in the curves described by the lines which mark them; sometimes they are separated longitudinally by a groove; sometimes they are complete or continued throughout the length; sometimes they exist on the last phalanges only; and lastly, in the aberrant genera they are hardly distinct. The modifications of this curious apparatus, as well as the absence or presence of the nails, afford the leading characters on which herpetologists have established the different genera, and we here present the various forms collected by M. Duméril.



Form and structure of the under part of the toes of *Geckotidæ*. The figure marked with the numeral only, represents the foot: the figure marked with the added letter *a*, represents the structure of the lower part of the toe. 2, *Platydactylus Cepedianus*; 3, *Platydactylus Ægyptiacus*; 4, *Platydactylus guttatus* (*Gecko verus*, Common Gecko, of Gray); 5, *Platydactylus homalocephalus* (*Ptychozoon*, of Kuhl; *Pteropleura*, of Gray); 6, *Platydactylus Leachianus* (*Ascalaboles Leachianus*; Griff., 'Anim. King.'); 7, *Hemidactylus Oualensis* (*Peropus*, of Wiegmann); 8, *Hemidactylus triedrus*.



The numerals and letters indicate the same parts as they do in the upper figure, with the exception of 7, *b*, which represents a claw in profile. 2, *Thecodactylus Theconyx*; 3, *Ptyodactylus Hasselquistii* (*P. guttatus*, of Rüppell, House-Gecko, Griff. 'Anim. King.'); 4, *Ptyodactylus fimbriatus* (*Gecko fimbriatus* of authors; Fimbriated Gecko, Griff., 'Anim. King.'); 5, *Phyllodactylus porphyreus*; 6, *Gymnodactylus scaber* (*Stenodactylus scaber* of Rüppell; *Cyrtodactylus*, of Gray?); 7, *Gymnodactylus pulchellus* (*Gonyodactylus pulchellus* of Wagler; *Cyrtodactylus pulchellus*, of Gray); 7, *b* represents a claw of the animal seen in profile.

Digestive System.—The numerous teeth of the Geckos are similar in form and length, placed on the same line, and fixed in a longitudinal furrow on the internal edge of the jaw by the external surface of their roots. The enamelled crowns are cutting, and their base is rounded. From their position in the jaw, Wagler has derived his designation Pleurodonts, the teeth being attached laterally while they are free internally, or in the furrow destined for their reception. In the greater number the crown increases from above downwards. These teeth are so closely set that they seem to touch each other, and altogether form a very trenchant dentilated blade, though not long enough for cutting up substances of any thickness, nor does the bite of the animal inflict a wound.

The œsophagus is very wide, and M. Duméril notices an extraordinary appearance therein, when it is remembered that the part is not exposed to the light. In many species, both living and dead, which he examined, he found the interior of this canal strongly coloured with different but uniform shades, sometimes of an orange-yellow, but principally of a deep black. There is no distinct limit between the œsophagus and the stomach; the crop (jabot) is continuous, and the whole forms a kind of longitudinal sac, which appears to be suddenly narrowed at the point corresponding to the pylorus, which is not to be detected except by this diminution of diameter and its position on the free and lower edge of the liver. The intestine is arranged in sinuous folds, and about three times the length of the œsophagus and ventriculus taken together, it turns to the left, and is lost on the side of a true and large cæcum, furnished with an appendage, and terminating by a large tube which has its opening in the cloaca.

The triangular liver is placed in the mesial line, but its upper angle is so much elongated, that in some species it forms a conical point, at least twice as long as the base. This point lies in front of the stomach in the space left by the two lungs when they are filled with air. Below, the liver enlarges, and is divided into many lobes or indistinct strips, with the exception of that on the left, which is longest. The gall-bladder is situated under the mesial lobe. M. Duméril states that there does not appear to be a pancreas, but he observed in the Common Gecko and in the Fimbriated Gecko (*Ptyodactylus fimbriatus*) a very small spleen situated on the left side of the stomach.

Circulating System.—The shape of the heart varies. In the Common Gecko it is large and flat, but has nevertheless a tolerably regular conical form, the point of the cone being below, and the base, which is slightly notched, leaning on the root of the two lungs. In the Fimbriated Gecko, on the contrary, M. Duméril states the heart to be proportionally smaller, and apparently formed of three distinct but approximated portions, the two upper rounded and oval, resembling auricles, and the other and lower portions small and conical. He acknowledges that he has not followed out the vascular system, but presumes that it resembles in its distribution that of the other Saurians.

Respiratory System, and Organ of Voice.—The glottis consists of a longitudinal slit with two large lips, which form a sort of tubercle behind the posterior notched portion of the tongue, the movements of which it follows, and can consequently be lifted up and applied to the concavity of the palate. The trachea is very large, and the rings, which are cartilaginous anteriorly but membranous on the side next to the œsophagus, cause it to be considerably flattened. The lungs form two sacs, as in the Salamanders, and are nearly equal in volume and length. Their internal cavity is simple, but there are polygonal cellules on their internal membranous linings, and in the lines forming these the arterial and venous vessels are ramified. The *Geckotidæ* are without any goitre, and M. Duméril is unable to account for the production of the voice, but he inquires whether the cry which they emit, and which is supposed to be in some degree imitated by their names of 'Gecko,' 'Geitje,' &c., may not be assisted by the movements of the tongue, and its reception in the concavity of the palate; analogous, we suppose, to the production of the sound with which a coachman or groom stimulates his horses by applying the tongue to the upper part of the mouth and suddenly withdrawing it.

Urinary and Genital Organs.—There is no urinary bladder, nor do the rounded kidneys, whose ureters are not long and open directly into the cloaca, require particular notice. The organs of generation in the males (which are smaller, more agile, and more brightly coloured than the females) are double, and lodged on each side of the base of the tail, which has consequently a swollen appearance. The eggs, which are often deposited between stones, are quite round, with a rather solid, slightly rough, calcareous shell, of a uniform dirty white. M. Duméril has seen these eggs produce the young ones, which were well-formed and very nimble.

The author last named states that he has observed in many species some peculiar organs, sometimes double, sometimes united in a single flattened elongated mass under the abdominal parietes in front of the pubis, in place of a urinary bladder. They appeared to be of a fatty nature, and were sustained in one part by the os pubis, and on the other possessed vascular or membranous single or double prolongations, rising in the thickness of the peritoneum as far as the liver. Though he knows not the office of these organs, he thinks it probable that they may be destined to afford nourishment to the animal in a state of hybernation. The pores of the thighs, &c. secrete a thick humor; and M. Duméril observes that these pores afford no generic character.

The *Geckotidæ* are none of them large in size, and the greatest number feed on small animals, such as insects, their larvæ and pupæ. These they catch either by lying in ambush or by pursuing their feeble prey in the holes and dark crevices to which it retires. The structure of their feet enables them to run in every direction over the smoothest surfaces, and they can even remain suspended beneath the large leaves which a luxuriant tropical vegetation so frequently puts forth. The sharp and retractile nails with which the feet of the greater number are armed, enable them to cling to and make rapid progress on trees with the smoothest bark, to penetrate the holes of rocks, and to climb walls. Of sombre or varying colours adapted generally to the locality where their lot is cast, they will often remain for hours in positions as extraordinary as the flies and insects for which they watch, the wonderful apparatus with which their feet is furnished enabling them to overcome the general law of gravity, and without which they would instantly fall to the earth. The hues of their skins thus render them less objects of suspicion to the little animals for which they lie in wait, and also serve to dodge even the acute eye of the bird of prey that seeks to destroy them. Their eyes, as we have seen, enable them to discern objects in the dark, and are at the same time capable of bearing the rays of a bright sun; for many insects are nocturnal or crepuscular, while the great mass of them are diurnal. The pursuit of their prey leads them near the habitations of man, whose dwelling always attracts certain kinds of insects, and they sometimes fall victims to their appearance, which frequently inspires terror, and often disgust. A Gecko, confident in his powers of flight, appears boldly to await his adversary, and his sudden disappearance at a nearer approach adds to the horror which his uncouth form inspires. The poor Geckos too have a bad name. They are supposed to poison whatsoever they touch, be it animate or inanimate, and their saliva is said to vex the skin of those on whom it falls with foul eruptions. Many of these cuticular irritations, when they have actually existed from the intervention of these animals, may have arisen from the extremely sharp claws of a Gecko running over a sleeping man, or small blisters may have been raised by the adherent apparatus at the bottom of its feet.

The *Geckotidæ* are found in all the four quarters of the globe, and are widely distributed in warm climates. In this distribution, Europe, as far as observation has yet gone, claims by far the fewest number. Two species only have yet been found in this quarter of the globe, and even these are common to the northern coasts of Africa. Prince C. L. Bonaparte has noticed them in the 'Fauna Italica,' under the names of *Ascalabotes Mauritanicus* and *Hemidactylus triedrus*. The former is a *Platydactylus* of Duméril and others.

Systematic Arrangement.—There can be little doubt that the Ἀσκαλαβώτης of Aristotle and of the Greeks generally was a Gecko. Aristophanes and Theophrastus, as Gesner has shown, speak of those lizards which the Italians called Tarentola, whose bodies were short and thick, and which clambered about the walls in the interior of their edifices for the purpose of catching spiders, on which they fed, under the names of *Ascalabotes* and *Galeotes*. That the *Stellio* of Pliny was no other than a Gecko, Schneider has shown.

Linnæus placed the Geckos under his great genus *Lacerta*, and recorded but three species (1766).

Laurenti (1768) seems to have been the first modern who established the Geckos as a genus. Gmelin (1789, 13th edit. of 'Syst. Nat.') introduced a section in the genus *Lacerta*, consisting of five species, under the name of *Gekkones*, and the term Gecko was used as a generic appellation for these Saurians by Lacépède (1790), Schneider (1797), Cuvier (1798), and Brongniart (1801).

Daudin (1803) divided the genus *Gecko* into three sections, taking for the basis of his division the number and connection of the toes, the form of the tail, and the disposition of the scales. These sections consisted of the Geckos properly so called, the Geckottes, and the Geckos with a flat tail. M. Duméril, who has written so much and so well on this subject, and to whose writings we are so much indebted, states that in 1806 he profited by the foregoing works, and established in the 'Zoologie Analytique,' and in his public lectures the genus *Uroplatus* (1806), and he says that Oppel, in his 'Prodromus' (1811), established the family *Geckotidæ* after his (Duméril's) indications. M. Duméril, who established also the genus *Urotornus*, adopts in great measure the system of Cuvier, and separates the *Geckotidæ* into two great divisions, each embracing subdivisions. These divisions take the structure of the toes for their basis; the first consisting of those *Geckotidæ* which have dilated toes, the second of those whose toes are not dilated. The subdivisions depend upon the variation in the structure of the lower part of the toes. The genera are—*Ascalabotes*, *Platydactylus*, *Hemidactylus*, *Ptyodactylus*, *Thecadactylus*, *Stenodactylus*, and *Gymnodactylus* (1836).

Cuvier (1817-1829) placed these Saurians under his great genus *Gecko*, which he divided into the following sub-genera:—*Platydactylus*, *Hemidactylus*, *Thecadactylus*, *Ptyodactylus*, *Sphæriodactylus*; at the same time arranging those Geckos which have retractile claws, but slender or rather not enlarged toes, in three groups, under the names of *Stenodactylus*, *Gymnodactylus*, and *Phyllura*, the latter embracing those with a horizontally-flattened foliated tail.

Merrem (1820) places the Geckos in the first tribe (*Gradientia*) of the class *Pholidoti*. The sub-tribe *Ascalabotes*, according to him, embraces the *Iguanidæ* as well as Geckos.

M. Latreille (1801-1825) seems to have adopted the views and descriptions of Lacépède in the first instance, and not to have gone much beyond a change of nomenclature in the last work published by him.

M. Fitzinger (1826) makes his Ascalabotoïds consist of the genera *Sarrubus, Uroplatus, Ptyodactylus, Hemidactylus, Thecadactylus, Ptychozöon, Platydactylus, Ascalabotes, Stenodactylus*, and *Phyllurus*.

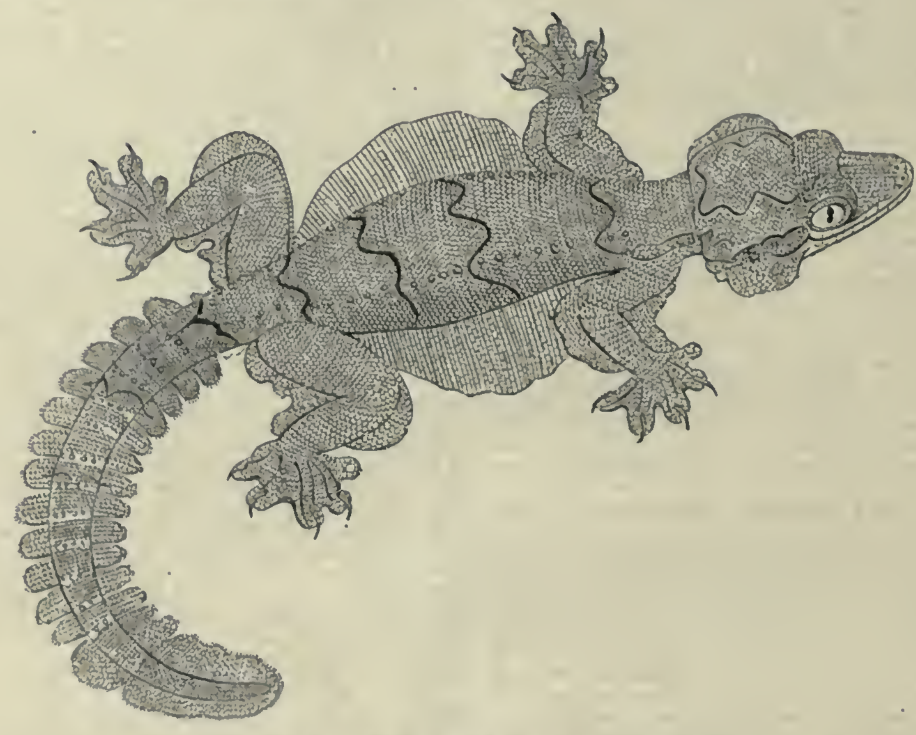
Dr. J. E. Gray (1827-1834) arranges the following genera under the family *Geckotidæ:—Hemidactylus, Platydactylus, Gecko, Pteropleura, Thecadactylus, Ptyodactylus, Phyllurus, Eublepharis, Cyrtodactylus, Phyllodactylus, Diplodactylus*, and *Gehyra*.

Wagler (1830), under the family name of *Platyglossi*, makes the *Geckotidæ* consist of the following genera:—*Ptychozöon* (Kuhl), *Crossurus* (Wagler—*Uroplatus* of Duméril in part), *Rhacöessa* (Wagler—one of Duméril's *Uroplati*), *Thecadactylus* (Cuvier), *Platydactylus* (Cuvier), *Anoplopus* (Wagler), *Hemidactylus* (Cuvier), *Ptyodactylus* (Cuvier), *Sphæriodactylus* (Cuvier), *Ascalabotes* (Lichtenstein), *Eublepharis* (Gray), *Gonyodactylus* (Kuhl), and *Gymnodactylus* (Spix).

Dr. Cocteau (1835) arranges the Geckos into six divisions:—1, *Platydactylus*, containing five subdivisions, represented in part by *Anoplopus* of Wagler, *Phelsuma* (Cocteau), *Pachydactylus* (Wiegmann), *Ptychozöon* (Kuhl), and *Pteropleura* (Gray), with others resting principally upon the absence or presence of pores before the cloaca, and the development of the claws; 2, those Geckos which correspond to *Thecadactylus* of Cuvier; 3, *Hemidactylus*; 4, comprehending *Ptyodactylus* (*Uroplatus*, Duméril; *Rhacöessa*, Wagler; *Crossurus*, Wagler); 5, *Sphæriodactylus*, comprehending *Diplodactylus* (Gray) and *Phyllodactylus* (Gray); 6, *Stenodactylus* (*Eublepharis, Gonyodactylus, Gymnodactylus, Cyrtodactylus, Pristurus, Phyllurus*).

M. de Blainville ('Nouvelles Annales du Muséum,' April, 1836) places the family of Geckos at the head of the family of Saurophians. The species forming the genus *Platydactylus* of Cuvier he designates as Geckos; those ranging under *Hemidactylus* as Demi-Geckos; the *Ptyodactyli* as Tiers-Geckos; the *Stenodactyli* as Quart-Geckos; and the *Gymnodactyli* as Sub-Geckos.

The following cuts will convey an idea of the form of some of the *Geckotidæ*:—



Platydactylus homalocephalus (*Ptychozöon*, Kuhl; *Pteropleura*, Gray).

1, *Platydactylus Seychellensis*. (Duméril.)
1, *a*, the underside of one of its toes.

1. *Gymnodactylus Miliusii* (*Cyrtodactylus Miliusii*, Gray).
1, *a*, the underside of one of its toes. (Duméril.)

The following is a synopsis of the genera and a list of the species, as given in the 'British Mnseum Catalogue,' 1845:—

Synopsis of the Genera of *Geckotidæ*.

I. Toes dilated, with 2 rows of membranaceous plates beneath, under the dilated part.

A. Last joint of the toes short, inflexed, sheathed in the notch between the front of the 2 series of plates. Claws 5-5.

a. Toes dilated, ovate, with 2 series of transverse equal plates beneath.

1. *Thecadactylus.*—Toes half webbed. Femoral pores none. Tail uniformly granular.

b. Toes linear, truncated, middle of the toes with 2 rows of sqnare plates beneath, the 2 terminal plates larger.

2. *Œdura.*—Tail subcylindrical, with square scales, unarmed. Toes all with 2 rows of small plates beneath.
3. *Strophura.*—Tail cylindrical, with 2 rows of spines above, tip revolnte. The 2 middle toes with 2 rows, the rest with 1 row of plates beneath.

c Toes linear, truncated, middle of toes with a single series of plates beneath, 2 terminal plates larger.

4. *Diplodactylus.*—Terminal pair of toe-plates convex, rounded at the end. Back and tail granular, uniform.
5. *Phyllodactylus.*—Terminal pair of toe-plates thin, square at the end. Back and tail tubercular.

d. Toes slender, dilated at the end, with 2 diverging series of plates beneath.

6. *Ptyodactylus.*—Toes free. Body simple. Tail round.
7. *Uroplates.*—Toes webbed. Tail and sides of the head and body fringed.
8. *Caudiverbera.*—Toes webbed. Tail and back with a membranous crest.

B. Toes, last joint slender, compressed, elongate, produced, clawed, free from the dilated penultimate joiuts.

a. Thumb with a compressed clawed termiual joint, like the toes.

9. *Hemidactylus.*—Tail rather depressed, angular above, with cross rings of spines, lower edge simple. Toes free.
10. *Velernesia.*—Tail rather depressed, angular above, with cross rings of spines, lower edge denticulated. Toes half webbed. Skin of sides and limbs lax.
11. *Doryura.*—Tail depressed, uniformly granular, denticulated on the edge. Toes free. Sides and limbs simple.
12. *Platyurus.*—Tail depressed, uniformly granular, denticulated on the edge. Toes half webbed. Sides and limbs with a thin membranous expansion.
13. *Leiurus.*—Tail cylindrical, uniformly grannlar, tapering. Toes slightly webbed. Sides and limbs simple.
14. *Crossurus.*—Tail cylindrical, granular, with a festooned fringe on each side.

b. Thnmb with a compressed, clawless, terminal joint.

15. *Boltalia.*—Toes free.

c. Thumb without any compressed terminal joint, clawless.

16. *Peripia.*—Toes all free.
17. *Peroplus.*—Toes two middle united at their base.

II. Toes more or less dilated, with a single series of transverse plates beneath.

C. Toes dilated, the last joint (only) compressed and rather produced or wanting, the plates beneath the toes membranaceous, smooth.

a. Claws 5-5. Thumb with a compressed, free, clawed last joint.

18. *Theconyx.*—Toes free, dilated. Sides simple.
19. *Pentadactylus.*—Toes free, base slender. Sides simple.
20. *Platydactylus.*—Toes webbed. Sides with a margin.

b. Claws 4-4. Thumb without any compressed, free, clawed, last joint.

21. *Gecko.*—Toes free, last joint short. Back tubercular.
22. *Gehyra.*—Toes free, last joint rather elongate, very compressed. Scales granular.
23. *Amydosaurus.*—Toes half webbed. Back granular. Limbs and body simple.
24. *Lyperosaurus.*—Toes half webbed. Back granular. Hinder edge of legs with a slight fold of thin membrane. Tail with a slight fringe.
25. *Ptychozoon.*—Toes webbed. Head, body, and tail with membranes on the side.

c. Claws 2-2. All but the two middle toes without any compressed last joint.

26. *Tarentola.*—Lower rostral shield very long.

d. Claws none. Toes all without any compressed last joint.

27. *Phelsuma.*—Toes dilated, ovate. Tail rather contracted.
28. *Pachydactylus*—Toes slender, short, apex rather dilated.
29. *Sphærodactylus.*—Toes slender, with a single rounded disc at the tip.

D. Toes and thumbs clawed, slightly dilated below at the base, the two or three last joints compressed, angularly beut, the membranous plates beneath the toes transverse, smooth.

a. Toes rather thick, tapering. Tail round.

30. *Naultinus.*—Tail cylindrical, tapering, granular. Preanal pores in 2 or 3 cross series. Back granular.
31. *Eublepharis.*—Tail cylindrical, ringed with cross series of tubercles. Back tubercular.
32. *Homonota.*—Tail cylindrical, tapering, granular. Preanal pores none. Back scaly.
33. *Pristurus.*—Tail compressed, dentated above.

b. Toes elongate, slender, compressed, versatile, joints bent at angle.

34. *Goniodactylus.*—Tail round, tapering, granular. Scales granular. Preanal pores none.
35. *Cyrtodactylus.*—Tail round, tapering, with rings of tubercles. Back with rows of tubercles. Preanal pores in 2 parallel rows.
36. *Heteronota.*—Tail round, tapering, with rings of tubercles. Back tubercular. Preanal pores in an arched series.

37. *Cubina.*—Tail round, tapering, with rings of tubercles. The back tubercular. Preanal and femoral pores none.
38. *Gymnodactylus.*—Tail rather depressed, tapering, with rings of tubercles. Back tubercular. Preanal pores in a curved series.
39. *Phyllurus.*—Tail depressed, cordate, end round, tapering.

E. Toes and thumbs clawed, cylindrical, tapering, toothed on the side, the plates beneath transverse, many-keeled, denticulated.

40. *Stenodactylus.*

List of the species of *Geckotidæ*, with the Localities they inhabit.

Thecadactylus rapicaudus, the Turnip-Tailed Gecko. Tropical America.
Œdura marmorata, the Marbled Œdura. North Australia.
Œ. rhombifer, the Lozenge-Spotted Œdura. West Australia.
Strophura spinigera, the Strophure.
Diplodactylus vittatus, the Yellow-Crowned Diplodactyle. Australia.
D. ornatus, the Beautiful Diplodactyle.
D. ocellatus, the Eyed Diplodactyle. West Australia.
D. marmoratus, the Marbled Diplodactyle. Australia.
D. bilineatus, the Two-Lined Diplodactyle.
D. lineatus, the Lined Diplodactyle. Cape of Good Hope.
D. Gerhopygus, the Naked Diplodactyle.
Phyllodactylus pulcher, the Phyllodactyle.
P. tuberculatus, the Large-Tubercled Phyllodactyle.
Ptyodactylus Gecko, the Fan-Foot. Egypt.
Uroplates fimbriatus, the Famocantrata. Madagascar.
U. lineatus, the Sharp-Tailed Famocantrata.
Caudiverbera Peruviana, the Caudiverbera. Peru.
Hemidactylus trihedrus, the Triangular-Tubercled Hemidactyle.
H. maculatus, the Spotted Hemidactyle.
H. Brookii, Brooke's Hemidactyle.
H. depressus, the Groove-Tailed Hemidactyle.
H. verruculatus, the Warty Hemidactyle. Shores of the Mediterranean; Egypt.
H. fasciatus, the Banded Hemidactyle.
H. Mabouia, the Brazilian Hemidactyle. Brazil.
H. mercatorius, the Wandering Hemidactyle.
H. frenatus, the Streaked Hemidactyle. Ceylon.
H. Leschenaultii, Leschenault's Hemidactyle. Ceylon.
H. vittatus, the Streaked-Cheeked Hemidactyle. Borneo.
H. Bellii, Bell's Hemidactyle.
H. Peruvianus, Wiegmann's Hemidactyle. Peru.
Velernesia Richardsonii, the Velernesia.
Doryura Bowringii, Bowring's Hemidactyle.
D. Garnotii, Garnot's Doryure. South Sea Islands.
Platyurus Schneiderianus, the Platyure. Java.
Leicerus ornatus, the Banded Leiurus. West Africa.
Crossurus caudiverbera, the Crossurus.
Boltalia sublævis, the Boltalia. India.
Peripia Peronii, Peron's Peripa. Mauritius.
P. variegata, the Variegated Peripa. Australia.
Peropus mutilatus, the Peropus. Manilla.
Theconyx Seychellensis, the Seychelle Gecko. Island of Seychelles.
Pentadactylus Duvaucelii, Duvaucel's Pentadactyle. India; Calcutta.
P. Leachianus, Leach's Gecko.
Gecko verus, the Gecko. India.
G. Reevesii, Reeve's Gecko. China.
G. Chinensis, the Japan Gecko. China and Japan.
G. Monarchus, the Amboyna Gecko. Borneo.
G. Smithii, Dr. A. Smith's Gecko. Prince of Wales Island.
G. vittatus, the Streaked Gecko. Cape of Good Hope.
G. bivittatus, the Double-Streaked Gecko.
Amydosaurus lugubris, the Sombre Gecko.
Gehyra oceanica, the Oceanic Gehyra. Islands in the Pacific.
G. Australis, the Swan River Gehyra. Swan River.
Lyperosaurus Cumingii, the Luperosaure.
Ptychozoon homalocephala, the Fringed Tree-Gecko. Java.
Tarentola Mauritania, the Tarentola. Egypt.
T. Ægyptiaca, the Egyptian Tarentola. Egypt.
T. Delalandii, Laland's Tarentola. Madeira; West Coast of Africa.
T. Americana, the American Tarentola. North America.
T. Borneensis, the Bornean Tarentola. Borneo.
T. clypeata, the Shielded Tarentola. Glasgow.
Phelsuma Cepedianus, Lacépède's Phelsuma. Mauritius.
P. Madagascariensis, the Madagascar Phelsuma. Madagascar.
P. lineatum, the Lined Phelsuma. Madagascar.
Pachydactylus ocellatus, the Eyed Gecko. Cape of Good Hope.
P. maculatus, the Spotted Pachydactyle. South Africa.
P. elegans, the Elegant Pachydactyle. South Africa.
Sphærodactylus sputator, the Banded Sphærodactyle. South America.
S. punctatissimus, the Lined Sphærodactyle. Martinique.
S. fantasticus, the Black-Headed Sphærodactyle. South America.
S. nigropunctatus, the Black-Dotted Sphærodactyle. South America.
S. Richardsonii, Richardson's Sphærodactyle. America.
Naultinus pacificus, the Pacific Naultinus. New Zealand.
N. elegans, the Kakariki. New Zealand.
N. Grayii, the Long-Toed Kakariki. New Zealand.
N. punctatus, the Black-Dotted Kakariki. New Zealand.
Eublepharis Hardwickii, Hardwick's Eublepharis. Penang; Chittagong.
Homonota Guidichaudi, Guidichaud's Scaled Gecko. Chili.
Pristurus flavipunctatus, Ruppell's Pristurus. Abyssinia.
Goniodactylus Timorensis, Boie's Angular-Toed Lizard. India.
G. Australis, the Australian Angular-Toed Lizard. Australia.
G. alboangularis, the White-Throated Angular-Toed Lizard. South America.
G. ocellatus, the Eyed Angular-Toed Lizard. Tobago.
G. Mauritanicus, the Algerine Angular-Toed Lizard.
Cyrtodactylus marmoratus, the Marbled Cyrtodactyle. Java. Philippine Islands.
C. pulchellus, the Beautiful Cyrtodactyle. Singapore.
Heteronota Kendallii, the Bornean Heteronote. Borneo.
H. Binoei, the Australian Heteronote.
Cubina fasciata, the Banded Cubina. Martinique.
C. D'Orbignii, D'Orbigny's Cubina. Chili.
Gymnodactylus Geckoides, the Gymnodactyle. Shores of the Mediterranean.
Phyllurus platurus, White's Phyllure. Australia.
P. Milinsii, the Thick-Tailed Phyllure.
P. inermis, the Spineless Phyllure. Australia.
Stenodactylus guttatus, Wilkinson's Stenodactyle. Egypt.

GEDD. [Esox.]

GEDRITE, a Mineral occurring in crystalline masses having a fibrous radiated or lamellar structure. Its colour is clove-brown. The streak gray or yellowish. The lustre submetallic, feeble. Hardness not above 5. Rough. Specific gravity 3·26. It occurs in loose stones near Gèdre in the Pyrenees. It has some resemblance to Anthophyllite and Hypersthene. It has the following composition:—

Silica	38·811
Alumina	9·309
Protoxide of Iron	45·834
Magnesia	4·130
Lime	0·666
Water	2·301

GEESE. [Ducks.]

GEHLENITE, a Mineral occurring in square prisms. It has a gray colour, and is nearly opaque. The hardness is 5 to 5·6. The specific gravity 2·9 to 3·1. It has the following composition:—

Silica	29·6
Alumina	24·8
Lime	35·3
Protoxide of Iron	6·6
Water	3·3

It fuses with borax with difficulty. It gelatinises with muriatic acid. It comes from the Jassa valley in the Tyrol. (Dana, *Mineralogy.*)

GEHYRA. [Geckotidæ.]

GELA'SIMUS, a genus of Brachyurous Crustaceans. [Ocypodians.]

GELATIN, an animal substance composed of Carbon, Hydrogen, Oxygen, and Nitrogen, found present in all parts of the body, and constituting the walls or external investment of the cells of which animals are composed.

Amongst the component parts of all organised bodies the most frequent is the cell. Modified in an infinite variety of ways, it gives rise to the innumerable varieties exhibited both by plants and animals, in the external form, the structure, and consequently the functions of their organs. In the vegetable kingdom the substance employed in the construction of these cells is cellulose combined with a little protein. In the animal kingdom it is gelatin. The case is very similar, although the elementary form of the tissue and its chemical characters are different. In animals we must distinguish between the persistent and the original cellular substance. The original in all probability varies in different cases, while the persistent exhibits a constant and general character. The persistent tissue is consequently a secondary product, and in this respect differs from the cellular substance in plants, which is a primary or original one; neither has it an actual cellular form like the latter. There is however a resemblance between the two in several points, especially in relation to the large proportions in which they both exist, and to the several functions which they perform.

Gelatigenous substance is so widely diffused over the body that it would exhibit the entire shape of the principal organs, even if all other constituents were separated. It constitutes the skin, the serous membranes, the cellular sheaths of the muscles, the organic portion of bone, and many other substances. It is insoluble in cold water; acetic acid renders it transparent and bulky; tannic acid renders it solid, and prevents its putrefaction; and when boiled it forms a jelly. It is in consequence of the last property that it has received the name of Gelatin. The gelatigenous substance (as in skin, areolar tissue, serous membranes, &c.) is insoluble in cold water, and on boiling is merely physically and not chemically altered. In the process of boiling nothing is taken up and nothing separated; the alteration being similar to that undergone by starch when heated in water.

The composition of Gelatin is represented by the formula—

$$C_{13}\ H_{10}\ N_2\ O_5$$

whether obtained from hartshorn, from isinglass, or from silk. Both boiled and unboiled cellular tissue (after its conversion into glue) combine with tannic acid, and produce compounds which are insoluble in water and resist putrefaction; hence the power of all medicines containing this substance to heighten the tone of the system. The protein-compounds in a similar manner form hard and coherent compounds with tannic acid. Peruvian and willow bark, catechu, and many other astringent medicines produce compounds of this nature in the organism.

On boiling Gelatin in water for a long time we obtain a hydrate of gelatin, which no longer gelatinises: its composition is $4\ (C_{13}\ H_{10}\ N_2\ O_5) + aq.$

This peculiarity should be remembered, for the compound is likely to be formed in the preparation of broth, and in the application of Papin's Digester to cooking; and it is regarded by Mulder as doubtful whether this hydrated gelatin can be again converted in the organism into nutrient matter, and whether it may not produce noxious substances in the body. [FOOD.]

As Gelatin has never yet been discovered in the vegetable kingdom, there is every reason to believe that it is solely produced in the animal body. It is most probably formed from the decomposition of the protein in the blood, through the action of the alkali in the serum, and the oxidising influence of the atmosphere.

We are likewise imperfectly acquainted with the products of the decomposition of the gelatigenous tissues in the body. Out of the body we know that by the influence of oxidation on gelatin prussic acid is formed, and that, by the action of alkalies, gelatin-sugar, leucin, and extractive matters are produced, while ammonia is disengaged, and an alkaline carbonate formed. Finally, when boiled in dilute sulphuric acid, it yields extractive matters with either gelatin-sugar or leucin. Since leucin is also produced from albumen when decomposed by potash, we perceive an intimate connexion between that protein-compound and gelatinous matters.

Besides the gelatin obtained from cellular tissue and serous membranes there is another kind which has many of its properties, but differs from it in composition. It was first described by Müller under the name of Chondrin. It is obtained from the cornea, and from those cartilages which do not ossify by boiling them in water. Its composition is $10\ (C_{32}\ H_{26}\ N_4\ O_{14}) + S$.

Gelatin is extensively employed in the arts in the form of glue, and constitutes the basis of leather. It is found pure in the air-bladder of some fishes, and on being cut up constitutes isinglass. When purified it can be formed into plates of almost glass-like transparency, and when coloured is employed for making artificial flowers and many other ornamental objects. Its relation to the other substances in the animal body are considered under PROTEIN.

GELDER ROSE, or rather, GUELDRES ROSE, a double variety of the *Viburnum Opulus*, a marsh shrub, common in this country and all the north of Europe. The name of this variety is supposed to indicate its origin in the Low Countries: it is also called the Snowball-Tree, in allusion to its large white balls of flowers. [VIBURNUM.]

GELIDIUM. [ALGÆ.]

GEMMASTREA. [MADREPHYLLIŒA.]

GEMMULINA. [FORAMINIFERA.]

GEMS-BOC. [ANTILOPEÆ.]

GENERATIONS, ALTERNATION OF. During the course of the development of many of the lower animals from the ovum to their adult condition, they not only pass through various forms, as is seen in the Insect tribes [INSECTS], but at certain stages of their growth they possess the power of multiplying themselves. The individuals which exhibit this phenomenon have been called 'nurses,' and the whole series of phenomena connected with this mode of reproduction have been called by its first expounder, Professor Steenstrup, an 'alternation of generations.' This phenomenon has been particularly observed in the *Acalephæ*, *Entozoa*, *Polypiferæ*, *Salpæ*, and *Vorticellæ*. In the various articles on these families of animals, their mode of development is described. As however this subject is one of general interest, and very imperfectly understood, we take the opportunity of reproducing here Professor Steenstrup's general remarks on this subject, from a translation of his work published by the Ray Society:—

"The mode of development by means of 'nurses,' or intermediate generations, is thus seen to be no longer an isolated phenomenon in nature. The circumstance of an animal giving birth to a progeny permanently dissimilar to its parent, but which itself produces a new generation, which either itself or in its offspring returns to the form of the parent animal, is a phenomenon not confined to a single class or series of animals; the vertebrate class is the only one in which it has not yet been observed. It would consequently appear that there is something intrinsic in this mode of development, and that it occurs as it were with a certain necessity; on which account it will undoubtedly soon be recognised to a greater extent and more generally. It should no longer be considered as something paradoxical or anomalous (as we have hitherto been too much inclined to deem both it and the phenomena in which it is exhibited), it must be in harmony with the rest of development in nature, in which the fundamental principle of this course of development must also be elsewhere expressed, although it may be displayed in a form under which we shall less readily perceive and recognise it. This is seen when we trace the mode of development in question more widely through nature; and whilst contemplating it through the phenomena in which it is manifested, we comprehend it in its true light.

"If we collect and regard in one view the whole system of development by means of 'nursing' generations, as it is exhibited in the Bell-Shaped *Polypes* (*Campanularia*), the Claviform *Polypes* (*Coryne*), *Medusæ*, *Salpæ*, *Vorticellæ*, and *Entozoa*, it appears as a peculiar and consequently as an essential feature in this course of development, that the species (that is, the species in its development) is not wholly represented in the solitary, full-grown, fertile individuals of both sexes, nor in their development; but that to complete this representation, supplementary individuals, as it were, of one or of several precedent generations are requisite. Thus, the distinction between this course of development and that which is generally recognised in nature, in which the species is represented by the individual (of both sexes) and its development, is the want on the part of the individuals of a complete individuality as representatives of the species, or of a specific individuality, if I may so express it. If now we agree to regard such an incompleteness in the individual as the essence of this development, we shall comprehend its significance in nature when we thoroughly consider this course of development in its various periods, throughout the above-mentioned families, how it begins and advances, so that at last we discover to what it tends. I believe, also, that we might trace even now this development by means of precedent, preparatory generations of 'nurses' in its peculiar course and advance, notwithstanding the paucity of instances adduced in the foregoing pages, and the many gaps in the series of observations. Thus we see the greatest incompleteness and the highest degree of mutual dependence in the *Campanulariæ* and similar *Polypes*, in which the generations representing the unity of the species are very unlike each other, and in which all the individuals are fused, as it were, into an outward unity, or into a set of *Polypes*. They exist, organically connected with each other, and are normally free only in their first generation, and indeed only in their earliest stage of development, and only for a short time, since the free-swimming ciliated embryo swims about in the water at most for some hours, in order to find a suitable place for the foundation of a new polype stem. In the *Corynæ*, or claviform *Polypes*, the organic connection between the individuals and generations is rather more lax; the perfect gemmiparous or ovigerous individuals are usually quite free, often even at an early age (*Coryne fritillaria*, *Corymorpha*), so that they do not attain their full development until after their separation from the 'nursing' generation. In the *Medusæ* and *Salpæ*, the generations which are connected together into one whole, become more like each other; the first generation of the *Medusæ* is still fixed but more active and mobile in its parts; the individuals of the perfect generation leave the 'nursing' animal while still very small, and undergo remarkable changes after they have become free and are swimming freely about; both generations of the *Salpæ*, finally, are free, and free swimmers, only the individuals of one of them are organically connected with each other; they have however no common organs (in the full-grown state), and if my explanation of the alternate generation of the compound Ascidians is correct, we have in that instance precisely the development of the *Salpæ* at a somewhat lower stage; the individuals of the one generation are organically connected, without having a common organ; but both generations are fixed.

"In the class of *Entozoa* a similar progressive attempt at becoming free and accomplishing a perfect growth appears evident to me.

"In the *Cestoidea* the generation of perfect individuals, constitutes externally a unity; they are only successively detached from each other as the term of their existence approaches, and their whole existence is throughout connected with the 'nursing' animal. In some of the *Trematoda*, the later generations remain within the earlier until they have attained their full development; in others they forsake them in an earlier condition, are free, and free swimming, and undergo a complete metamorphosis; in some of these latter, the earlier generations are transformed into motionless, and, as it were, lifeless cysts, whilst in others they remain free and active (the 'nurses' and 'parent nurses' of *Cercaria ephemera* and *C. echinata*), but retain during their whole life a form which, at most, resembles the larvæ of the more perfect generation. In this way an advance in a certain direction may indisputably be observed. At first all the generations constitute a unity, not merely as regards the interior, but also with respect to the exterior: they form a stationary colony; after which the generations are detached more and more from each other, and become at the same time more free; and, finally, all the individuals constituting the generation are separate from each other, and acquire the power of free locomotion. In this latter stage, or that of freedom and perfection, we found the development of animals which are certainly no longer attached to inanimate objects at the bottom of the sea, but live buried in other animal organisms, and belong not to the sea but to fresh water. In a still higher and more free stage than this we observe the development of animals which do not belong to the water, but to the air, as in that which occurs in the *Aphides*. The propagation of these creatures through a series of generations has been already long known. In the spring, for instance, a generation is produced from the ova, which grows and is metamorphosed, and without previous fertilisation gives birth to a new generation, and this again to a third, and so on, for ten or twelve weeks; so that in certain species even as many as nine such preliminary generations will have been observed; but at last there always occurs a generation consisting of males and females, the former of which, after their metamorphosis, are usually winged; fertilisation and the depositing of eggs takes place, and the long series of generations recommences in the next year, and in the same order. All the individuals are free, and enjoy the power of free locomotion, and undergo a metamorphosis. Here, however, we have before us aerial animals, and which are no longer parasites inhabiting other organisms; at most they are only externally parasitic, and on plants alone; the phenomena of this mode of development are no longer exhibited by *Entozoa*, but by *Epiphyta*. Nevertheless, the course of development is in itself similar; but in the external, more free, and nobler form in which it is now exhibited, the endeavour to attain something higher is manifest. Each link or generation certainly brings its offspring nearer to the perfection aimed at; but this approachment towards perfection is effected only by means of the 'nursing' by special animals, and is committed to the still and quiet activity of an organ, without the nursing animals themselves being conscious of it; it is a function merely, and not an expression of the will. In all parts of the animal kingdom we see instances of the still, quiet, and unconscious activity of the animal being developed into voluntary actions, which are undertaken by it from an internal, obscure, and irresistible impulse (or artificial impulse), as is the case in this instance. The development and mode of feeding or nourishing the young, exhibited in its course, of Bees, Wasps, Ants, and *Termites*, affords a direct example of the mode in which the care of the young is provided for, by the voluntary action of numerous individuals devoted to that object. Those of the young which are to be developed into the more perfect, fertile individuals are not protected in the body of the foster-parents, nor is their nourishment secreted by one of the organs; both protection and food are afforded them by means which are brought about by the conscious activity of the 'feeders.' The Wasp, for instance, or the Wild Humble-Bee, which has been impregnated in the autumn, and has afterwards sought a shelter to protect itself against the cold of winter, prepares a solitary habitation in which it builds cells and deposits its eggs. From the eggs proceed larvæ, but the insects into which these larvæ are metamorphosed, are not fertile; they are barren, and all their faculties are directed to the assisting of the parent animal in the better nourishing of the future brood, to which end some of their external organs are transformed, and to the erection of a better habitation and cells, into which they convey the eggs of the female, and the food of the larvæ to be developed from them. Other cells, which contain a better sort of food, are erected for a later and less numerous progeny of eggs; and again in others, which are more roomy and provided with the best kind of food, but of which there are only a few, is the last brood of the female deposited. From the first kind of cells proceed the barren individuals, from the second the males, and from the third the females; after undergoing a metamorphosis, the males and females fly away, impregnation takes place, and the males die; the females however return, and the whole multitude of barren individuals, which at the same time perform the duty of feeding the young, build cells for their various progeny of eggs, and nourish the three forms of larvæ which proceed from them. In this way the inhabitants of the colony become very numerous; nevertheless they all die off in the winter: the fertile females alone remain alive, and propagate the species the year following, under the same development of alternating broods, the earlier of which is always by far the most numerous, and assists in the development of the latter. In the colonies of Bees, Ants, and *Termites*, the same thing occurs; the many thousand individuals which constitute one of these colonies are principally 'feeders,' or individuals which have originated in the precedent divisions of the eggs of the females, and in these is exhibited, even with greater precision, a more marked division of labour in the feeding of the progeny; so that, out of the various precedent divisions, individuals apparently arise which assist in the development of the more perfect progeny in various ways. Thus there are in a hive of bees, individuals which are employed almost wholly in the feeding of the larvæ (foragers), whilst others do scarcely anything else than collect wax and build cells (workers). In ant-hills, one set of the feeders is constantly employed in conveying the larvæ from one place to another, according as they require a greater or less degree of warmth, &c., whilst others are engaged in building the passages or earth-cells, and in making excavations around the habitation. Among the *Termites* also we are acquainted with several forms of 'feeders,' constituting particular tribes or classes; the description of labour, however, which each of these classes performs, is unknown. It is known, however, that a form with a large head and strong jaws is always posted at the entrance of the artificially constructed dwelling, and keeps guard there as soon as any disturbance is remarked, and thus constitutes the safeguard not only of the young but of the whole community.

"Now in the cases in which the more perfect development of the progeny is promoted, either by means of 'nurses' or of 'feeders' (under which latter term we understand special individuals devoted to the actual care or nourishing of the young, which office they fulfil by a conscious activity), we see that nature always has in view the production of a multitude of individuals to whose life or care is then committed the perfecting of a later generation or progeny, consisting of less numerous individuals. This previous or preparatory multitude seems to consist invariably of females, the males being apparently excluded from any participation in the office, on which account the males of all the animals among which the system of 'nursing' or of 'feeding' obtains, constitute a very subordinate number. That the 'nursing' should be committed to females alone appears to us very natural, since we are acquainted with an organ in them whose natural function would be to perform that office. The generative organs are, indeed, in perfect (female) individuals divided, as it were, into two parts of very distinct natures; the ovarium for the preparation of the germ and the production of the egg, and the oviduct and uterus, in which the ova are, as it were, incubated, and the germ and embryo sufficiently developed to allow of its being born. Now, it is actually the case that no true ovary has been discovered in the 'nursing' generations; on the contrary, the germs, as soon as they are perceptible, are situated in organs which must be regarded as oviducts and uteri, as, for instance, in the most perfect 'nurses' we are acquainted with, the *Aphides*. In the 'nurses' of the trematode larva, the *Cercaria echinata*, I have remarked that the germs in their earliest condition are collected into an organ at the root of the tail, which may probably be regarded as a uterus, and that they appear to distend this organ gradually to the size of the whole body. The accurate anatomical researches of Professor Eschricht on the *Salpæ* also show in the most precise way that the associated brood of the *Salpæ* does not originate from ova, but that, as germs which are arranged in a definite manner between the walls of a hollow organ, it is contained in what can in no case be an ovary, and which the author has termed a 'germ-tube.' This organ lies in a cavity which may probably be considered very nearly a uterus, which is however always, as it were, a secondary receptacle for the germs; but in the present instance it cannot be shown that they have occupied any previous receptacle or place of formation.

"From what we at present know, we may probably assume with some degree of certainty that the 'nursing' individuals are never themselves gemmiparous, but that they are born with germs in the organs in which the embryos are afterwards nourished; and from all this it appears as if the female generative organism were always divided in those cases in which development by means of 'nurses' occurs, so that as in the more perfect females an ovary especially is formed, so in the 'nursing' individuals a much-developed uterus is presented, in consequence of which, they, as individualised uteri, have assigned to them, as the object of their existence, the performance of the functions of a uterus, and their complete formation must thus necessarily precede that of the germs which are committed to their fostering care. We cannot readily perceive the reason, that because all 'nursing' individuals must be of the female sex, it should follow that all those individuals which feed the young should also be of that sex, and yet this seems to be the law. Anatomy shows us that the 'feeders' among bees, wasps, &c., and probably those of all insects living in regular societies, are females, whose sexual organs remain in an undeveloped state. They present scarcely the vestige of an ovary; the uterus is rudimentary, and all propagation consequently in the material way, so to say, is rendered impossible; the imperfection of the organ does not even allow of their acting as 'nurses,' and the propagative instinct in a physical, corporeal sense passes into a will for the propagation of the species, into a *nisus* impelling to the feeding or nourishing of the young; and the fulfilment of these impulsive duties is favoured by the peculiar transformation which some of the organs undergo at the expense of those intended for propagation, in order that they may become adapted to the bringing up of the young. Whence it follows that the development of the species in this case does not take place by means of several generations, but through several broods of the same generation. The reason of the great number of 'feeders,' and for the common good of 'workers,' so that they often constitute thousands, whilst the fertile individuals scarcely amount to hundreds, may be readily understood when we consider more closely the regular societies of bees and ants, and witness the labour required for the nourishment of the young. But, on the other hand, how the development of the species is promoted by the multitude of 'nursing' animals of which we often see thousands for each single fertile one, appears to us difficult of explantion, since, even all of them can only be regarded as animated organs, which do not appear to act for or with each other. It does not however seem to me improbable that even the *Aphides*, trematode nurses, and other parasites, which are so immediately injurious to the organisms in or upon which they live, are not destined merely to promote the extension of the species, but that they also induce in the organisms themselves conditions necessarily more and more favourable to a later generation; plants also and animals afford us many instances that to a certain abundance of parasites there usually succeeds a complete overflow of them.

"I conclude with the remark that, inasmuch as in the system of 'nursing' the whole advancement of the welfare of the young is effected only by a still and peaceful organic activity, is only a function of the vegetative life of the individual, so also all those forms of animals in whose development the 'nursing' system obtains, actually remind us of the propagation and vital cycle of plants. For it is peculiar to plants, and, as it were, their special characteristic, that the germ, the primordial individual in the vegetation or seed, is competent to produce individuals which are again capable of producing seeds or individuals of the primary form or that to which the plant owed its origin, only by the intervention of a whole series of generations. It is certainly the great triumph of Morphology, that it is able to show how the plant or tree (that colony of individuals arranged in accordance with a simple vegetative principle or fundamental law) unfolds itself, through a frequently long succession of generations, into individuals, becoming constantly more and more perfect, until, after the immediately precedent generation, it appears as calyx and corolla, with perfect male aud female individuals, stamens, and pistils (so that even in the vegetable kingdom the grosser hermaphroditism does not obtain, which is still supposed to take place in the animal); and after, the fructification brings forth seed, which again goes through the same course. It is this great and significant resemblance to the vegetable kingdom, which in my opinion is presented by the *Entozoa* and all 'nurse' generations, and to which I have alluded in the preceding Essay: I might almost say that the condition of continued depeudence incidental to the animal life, is to a certain extent one of less perfection than that which is presented in the progressive elevation in development effected by the agency of the vegetative life."

GENET. [VIVERRIDÆ.]

GENISTA (the Latin *Genista*), a genus of Plants belonging to the natural order *Leguminosæ*. The calyx is 2-lipped; the upper lip bifid, the lower trifid. It has a subulate ascending style; a terminal oblique introrse stigma. The species have yellow flowers, and most of them yield a yellow dye. The *Planta Genista*, or Whin, the Gen of the Celts, and the Gênet of the French, was the badge of a long race of English kings, hence called Plantagenets. Upwards of eighty species are included in this genus, but few are applied to any important uses. They are found principally in the south of Europe, and some few are natives of Great Britain.

G. pilosa, has a smooth procumbent stem, and obovate lanceolate obtuse leaves; ovate hlunt stipules. The peduncles, calyx, and underside of the leaf are silky, and the pods hairy. It is a uative of the south of France, and is also found in Suffolk and Cornwall in England, in sandy places.

G. tinctoria, Dyer's-Weed, or Woad, has a depressed stem, with erect branches, without thorns; lanceolate leaves, hairy at the edges; minute subulate stipules; racemose flowers; and glahrous corolla and pods. The branches are from one to two feet high, glabrous and downy above. This plant is a native of Europe, and is found in pastures, fields, and thickets in England. The flowers yield a yellow colour, which is much used for dying wool. When cows are allowed to feed on this plant their milk becomes bitter and disagreeable, and the unpleasant taste of cheese and butter is often attributable to this cause. *G. tinctoria* has also a medicinal reputation. The seeds act as a mild purgative, and the ashes are also said to be a valuable diurectic.

G. anglica, Needle-Whin, has a spinous ascending stem, leafless below; uuarmed glabrous flowing branches; ovate-lanceolate leaves; and glabrous stems and corolla. It is a native of Europe, in France and Denmark, and is found in Britain ou moist boggy commons.

G. acanthoclada has trifoliate leaves, nearly sessile; linear, complicated, silky leaflets; stiff and spinose branches. The flowers almost opposite, and disposed along the branches in a kind of interrupted spike. It is a native of the Levant in exposed places, and in the island of Melos. This plant appears to be the *Μέλαινα ῥίζα* of Hippocrates, *Σκορπίος* of Theophrastus, and the *Ἀσπάλαθος* of Dioscorides.

G. Hispanica has lanceolate villous leaves; branched stiff spines; terminal racemes, somewhat capitate. It is a native of Spain and the south of France. Fraas states that this species is the 'genista' of Roman writers (Virgil, 'Georg.' ii. 434; Pliny. xxvi. 9. 12, 22. 24, 9; Columella, 4, 31).

G. purgans is an erect branched shrub with very few leaves, and axillary flowers on short pedicels. It is a native of Frauce, on hills, especially in the Cevennes, where it is used hy the villagers as a cathartic.

G. monosperma has erect branches; very few linear oblong leaves, clothed with a depressed pubescence; and lateral few-flowered racemes. It is a uative of Spain, Portugal, Barbary, and Egypt. On the shores of Spain it is found to be very useful in binding the otherwise drifting sand, and by its beautiful fragrant blossoms it converts a barreu waste into a lovely garden. The goats feed on the leaves and young brauches, of which they are particularly fond. The Spaniards call both the plant and the districts over which they grow Retamas, from the Arabic word Rætam. The species of this genus thrive well in a mixture of loam, peat, and sand, and young cuttings will easily strike in a potful of sand with a bell glass over them, which must be taken off aud wiped occasioually, lest the cuttings absorb too much moisture.

(Don, *Dichlamydeous Plants*; Bahiugton, *Manual of British Botany*; Fraas, *Synopsis Plantarum Floræ Classicæ*; Burnett, *Outlines of Botany*.)

GENTIANA, a genus of Plants belonging to the natural order *Gentianaceæ*. It has a 4-5-parted calyx. The corolla is variously divided, twisted to the right in æstivation, often with accessory lobes between the principal ones, without depressed glands upon the petals. The filaments equal at the base; anthers not changiug. The stigmas are terminal on the ovary or style. The placentæ united with the endocarp and overspreading the valves of the capsule.

G. Catesbæi is found in wet grassy meadows in the southern parts of the North American Union. It has a branching fleshy root. The stem is simple, erect, and rough. The leaves opposite, ovate, or lanceolate, slightly 3-nerved, acute, rough on the margin. The flowers crowded, nearly sessile, axillary, and terminal. The segments of the calyx linear lanceolate, varying in length, exceeding the tube and sometimes more than twice its length. The corolla is large, blue, ventricose, plaited, its border 10-cleft; the 5 outer segments roundish and more or less acute, the 5 inuer hifid and fimbriate. The stameus are 5 in number, with dilated filaments, and sagittate anthers. The ovary is oblong, lanceolate, compressed, supported by a sort of pedicel. The style is absent, stigmas 2, oblong and reflexed. The capsule oblong, acuminate, 1-celled, and 2-valved. The dried root is mucilaginous and sweetish, then inteusely bitter, approaching to *G. lutea*. It is said to be the hest substitute for that species.

G. Amarella has a salver-shaped 4-5-cleft corolla, bearded in the throat; the calyx-lobes 5, nearly equal, lanceolate; the leaves sessile, ovate, lanceolate; the radical leaves obovate. It is very variable in size and in the number of the flowers. It is from 3 to 12 inches high, erect. The stem square, much branched. The flower is of a pale purple colour, barely an inch long; the mouth of the tube is crowned by a fine erect purplish fringe rather shorter than the limb, and rising much above the stameus. The stamens answer in number to the divisions of the calyx and corolla, being almost always 5, awl-shaped, with roundish separate anthers. The styles are very short; the stigmas ovate. This species is a British plaut, and is one of the suhstitutes for the true Gentian sold in shops.

G. campestris is rather paler than the last species and of more humble growth, varying greatly in luxuriauce. The stem is somewhat corymbose, with simple flower-stalks of various lengths. The leaves are ovate, acute, and 3-ribbed. The flowers are somewhat larger than in *G. Amarella*, 4-cleft, essentially distinguished hy having the two outer and opposite segments of the calyx ovate and very hroad, covering the two inner, which are narrow and lanceolate, or even awl-shaped, all deeply serrated, and minutely fringed. This species is found in Great Britain and in elevated pastures in many parts of Europe. It is used as a substitute for the officinal Gentian.

G. purpurea is native of Swizerland, Savoy, the Pyrenees, and Norway. It has a simple and sub-divided root, many-crowned, taper, thickish, long, yellow outside, white inside, inteusely bitter. The stem is obscurely 4-cornered, green or greenish-purple, from 1 to 2 feet high. The radical leaves are ovate, or ovate-lanceolate, apiculate; those iu the middle of the stem ovate-lanceolate, scarcely acuminate, the uppermost sessile, broad, lanceolate, uniting and sheathing at the base, all 5-nerved, flexible, aud bright shining green. The flowers are terminal and axillary on short stalks. The calyx is oblong, scarious, semi-transparent, slit longitudinally on the inner side. The corolla is large, rather coriaceous, with a few scattered dots arranged in rows iu the inside; the tube yellow and striated, the limb 6-cleft, with broad obtuse segments distant at the base. The seeds are brown, orbicular, and winged. It is employed with the next species in continental practice.

G. Pannonica has a tapering root, little branched, many-crowned, rugose, as much as 2 feet loug, thick, yellowish-brown outside, whitish inside. The stem is round, green, or purplish, from 1 to 2 feet high. The leaves are ovate, somewhat apiculate, 5-uerved, the petioles running dowu into a sheath, those on the middle of the stem ovate-lanceolate, long; those at the top acuminate, about 3-uerved; all somewhat coriaceous and bright green. The flowers are sessile, or on very short stalks (the upper whorl many-flowered), large, an iuch aud a half loug. The calyx is campauulate, obsoletely 5-cornered, about 6-cleft, varied with red and green; the segments almost leafy and unequal, divided by a wide sinus, sometimes serrulated, shorter than the tube. The corolla is coriaceous, membranous, purple, with a yellowish tube, marked all over into rows of deeper spots, the segments ovate, rather blunt, thrice as short as the tube. The seeds are brown, winged, and round. The roots are extremely bitter, and are used extensively in Bavaria and Austria in medicine.

G. Kurroo is found in various parts of the Himalayas. It has a stem about 1-flowered, obtuse leaves, the radical long, lanceolate, those on the stems linear. The teeth of the calyx are long and subulate. The corolla is funnel-shaped, with an intense blue spreading 10-lobed limb, the principal lobes of which are ovate and acute, the intermediate ones scale-like teeth. The root is used like Gentian in the north of Italy.

G. lutea, the Common Gentian, is found in alpine meadows throughout the middle of Europe. It has a cylindrical root, wrinkled, ringed, thick, forked, brown externally, yellow within. The stem is 3 or 4 feet high, hollow, and stout. The radical leaves are ovate-oblong, 5-nerved, 2 or 3 inches broad, those on the stem sessile, ovate, acute; those next the flowers cordate, amplexicaul, concave, all a pale bright green. The flowers are bright yellow, in many-flowered whorls, stalked. The calyx is of a papery texture, and semi-transparent, 3- or 4-cleft, with short lanceolate unequal segments. The corolla with a very short tube, and 5 or 6 green glands at the base, 5- or 6-parted, with oblong acute veiny lobes. The anthers are subulate, somewhat united, becoming distinct. The stigmas revolute. The capsule oblong and stalked. The seeds roundish, compressed, with a membranous brownish border. The root of this species furnishes the Gentian of commerce, a valuable bitter drug employed extensively in certain forms of dyspepsia, in intermittents, and as an anthelmintic. In full doses it is apt to relax the bowels, and it does not always agree with the stomach, in fact, it possesses a volatile principle capable of producing nausea and a kind of intoxication. The root contains a good deal of sugar and mucilage which enables the Swiss to prepare from it a liqueur held in high esteem among the people.

G. nivalis, *G. verna*, and *G. Pneumonanthe* are all described as British species.

The following is an arrangement of the European species of this genus:—

A. Tube of the corolla short or greatly enlarged at the mouth. Throat naked; segments not fringed.
- I. Flowers in whorls or heads.
  - *a*. Corolla without accessory plaits.
    G. lutea; *G. Thomasii*; *G. biloba*; *G. Charpentieri*; *G. Gaudiniana*.
  - *b*. Corolla with accessory plaits.
    1. Calyx a sheath deeply divided on one side.
       G. Burseii; *G. purpurea*; *G. macrophylla*.
    2. Calyx campanulate, with nearly equal teeth.
       G. Pannonica; *G. punctata*; *G. cruciata*.
- II. Flowers solitary or in pairs. Corolla with accessory plates.
  G. asclepiadea; *G. Pneumonanthe*; *G. Frœlichii*; *G. frigida*; *G. acaulis*; *G. excisa*.

B. Tube of the corolla cylindrical, or somewhat barreled. Throat naked. Segments not fringed.
- I. Perennial. Stems numerous, simple, 1-flowered.
  G. Bavarica; *G. brachyphylla*; *G. verna*; *G. æstiva*; *G. imbricata*; *G. pumila*; *G. Pyrenaica*.
- II. Annual. Stem single, branched, many-flowered. No barren shoots. Styles cloven.
  G. prostrata; *G. utriculosa*; *G. nivalis*.

C. Throat or corolla bearded. Root-leaves obovate; stalked.
- I. Calyx tubular, 4- or 5-toothed.
  G. campestris; *G. Germanica*; *G. Amarella*; *G. obtusifolia*;
- II. Calyx 4- or 5-partite. Stem branched only at the base. Flower-stalks long and naked.
  G. tenella; *G. nana*.

D. Throat naked. Segments of corolla fringed.
  G. ciliata.

As ornamental objects these plants are remarkable for the brilliant colours and beautiful forms of their flowers. The species are extremely numerous, inhabiting the temperate parts of Europe, Asia, and America, chiefly in mountainous situations, where they breathe a pure and rarified air, are exposed to bright light during the short summers of such regions, and although fixed during winter in places intensely cold, yet are so well prepared to resist it by the warmth of their summer, and so much protected by the snow that covers them, as to suffer no injury. These alpine plants are consequently difficult to cultivate, or even uncultivable, from the impossibility of imitating their natural atmosphere; and hence it is only a very small number that are ever seen in gardens. The prevailing colours of their flowers are either an intense pure blue, or a bright clear yellow: some idea may be formed of the brilliancy of the former from that of *G. acaulis*, a common species in gardens, where it is much employed for making edging to borders; the yellow species are equally represented by *G. lutea*.

The ornamental species that are found easily capable of cultivation are *G. lutea*, with yellow, and *G. asclepiadea*, *G. saponaria*, *G. cruciata*, *G. septemfida*, *G. acaulis*, and *G. Pneumonanthe*, with blue flowers. Of these all require a good American border of peat-earth to grow in, with the exception of *G. acaulis*, which prefers the hardest and stiffest clay. Many other species are named in gardening books, but they generally perish as soon as they are brought under the hands of the cultivator.

(Lindley, *Vegetable Kingdom*; Wood, *Tourists Flora*; Babington, *Manual of British Botany*.)

GENTIANA'CEÆ, *Gentianworts*, an extensive order of Plants belonging to the Monopetalous Exogens, and consisting of herbaceous plants, with opposite ribbed leaves, and flowers whose corolla is imbricated; the stamens alternate with the petals; the ovary superior, with two cells standing right and left of the axis of growth; and seeds containing a minute embryo lying in a mass of albumen. They are generally considered to be in the closest alliance with *Scrophulariaceæ*, but it is possible that their resemblance to that order is one of analogy rather than affinity. Along with *Orobanchaceæ* and *Monotropaceæ*, they seem rather to belong to the albuminous group of Exogens, as has already been shown. [EXOGENS.] The flowers of these plants are usually coloured with pure bright yellow, red, or blue, and in many cases they are on this account among the most beautiful of flowers; but if we have a high development of form and colour in the majority of the species of this order, so we also have in the Guayana and Mexican plants belonging to the genus *Voyra* or *Leiphaimos* the brown leafless habit and low development of *Orobanche*. This order is famous for its bitterness, which seems to pervade all the species. *Gentiana* itself furnishes all the officinal kinds; but *Erythræa Centaurium* [ERYTHRÆA], a beautiful wild flower common in many parts of England, is advantageously employed by country people as a substitute; and the root of *Frazera Walteri* [FRAZERA] has been used as a means of adulterating the bitter Calumba-root. *Cherayta*, a Himalayan annual, is remarkable for the pureness of its bitter. The whole plant is pulled up at the time the flowers begin to decay, and dried for use. There are 60 genera and 450 species of this order.

2 3 1

Common Gentian (*Gentiana lutea*).

1, a capsule; the same cut across to show the placentæ; 3, a vertical section of a magnified seed.

This order extends over almost all parts of the world, from the regions of perpetual snow upon the summits of the mountains of Europe, to the hottest sands of South America and India. They however do not appear in the Flora of Melville Island; and they form part of that of the Straits of Magellan. The most common genus is *Gentiana*, than which few genera display so full a series of colours in the flowers; red, blue, yellow, and white are all exhibited in it, with many of the intermediate compound tints. For the properties of the genera of this order see CICENDIA, CHLORA, MENYANTHES, VILLARSIA, AGATHOTES.

GENUS, an assemblage of species allied by common characters, and subordinate to an order, family, tribe, or sub-tribe. A genus is frequently a natural assemblage, but almost every naturalist has his own particular views with regard to the propriety of uniting or separating particular groups of species; it is therefore often an arbitrary group. It is thus that the synonymy of genera becomes every day more copious, and it is one of the difficulties with which the naturalist has to contend in his studies. At present there are no generally recognised rules for the construction of genera amongst plants and animals. [FAMILIES OF PLANTS; ORDERS; SPECIES.]

GEOBDELLA. [ANNELIDA.]

GEOCICHLA, a genus of Birds established by Mr. Gould for a pretty species resembling the Redbreast (*Erithacus Rubecula*, Swainson). It belongs, he observes, to an interesting group which was first characterised by M. Kuhl, and of which the collection of the Zoological Society possesses four well-marked species. ('Zoological Proceedings,' 1836.)

GEOCOCHLIDES, Latreille's name for the Shell-Snails. Trachélipodes Colimacéa of Lamarck; Limacinés of De Blainville; Limaçons of De Férussac.

GEOCRONITE, a Mineral occurring amorphous without cleavage. The fracture is lamellar in one direction, and in the other granular and conchoidal. The colour lead-gray; streak the same. Hardness between mica and calcareous spar. Lustre metallic. Opaque. Specific gravity 5·88. It is found in the silver-mine of Scala in Sweden, and in the province of Galicia in Spain. An analysis of the mineral from the Scala mine by Svanberg gives—

Lead	66·452
Antimony	9·516
Arsenic	4·695
Copper	1·514
Iron	0·417
Zinc	0·111
Sulphur	16·262

GEMOEYDÆ. [CHELONIA.]

GEOFFRÆA, a genus of Plants belonging to the natural order *Leguminosæ*. One of the species, *G. inermis*, sometimes known as *Andira inermis*, is a native of Jamaica, Trinidad, Martinico, Porto Rico, St. Domingo, and Guyana, in woods and on river-banks. It has 13 or 15 ovate-lanceolate leaflets, acute, glabrous on both surfaces, the flowers pannicled on short pedicles; calyx urceolate, clothed with rusty pubescence. The flowers are arranged in terminal and axillary ferruginous panicles, very showy, with reddish lilac petals. The legume is the size of a large plum.

The bark of this tree is of a grey colour externally, but black and furrowed on the inside. The powder looks like jalap. It has a mucilaginous and sweetish taste, and a disagreeable smell. Its medical effects are great. When properly exhibited it operates as a powerful anthelmintic. It is given in the form of a powder, decoction, syrup, and extract, but should always be given in small doses; in large doses it is poisonous, producing violent vomiting, with fever and delirium.

GEOLOGY, the science of the earth (as the Greek words γῆ and λόγος may be translated), includes, in a large sense, all acquired or possible knowledge of the natural phenomena on and within the globe; whether these be now of frequent occurrence, the result of the existing combinations of physical agencies, or remain as monuments and measures of those agencies in earlier periods of the history of the planet.

Some of these phenomena are witnessed in connection with inorganic bodies, and depend in a great degree on the laws of force which appertain to and distinguish from each other the particles of matter; others are exemplified in organised structures endowed with vital functions related to those structures; and there may yet be distinguished a third order of effects, influencing and combining with both of the former, and depending on laws of force which affect the whole mass of the globe, as gravitation, or derived from extraneous agency, as light.

If at any certain epoch (as the present time) the phenomena thus classed were known in detail, and reduced to general laws which truly expressed the individual cases, the actual condition of the earth would be really known; if further it were possible to collect sufficient evidence from monuments preserved in the earth of its exact state at some former epoch, the variations to which terrestrial phenomena are subject would be disclosed; and by the comparison of several such surveys, taken at distant times, the laws of these variations would be revealed with an exactness proportioned to the certainty with which the intervals of time were determined. These laws of the variation of the condition of the globe at successive epochs, combined with the laws of chemical, vital, and mechanical action, which are assumed to be essential and constant, independent of time, and exempt from change, will furnish one, and only one, satisfactory general contemplation or theory of the origin, structure, and successive changes of the globe, considered as part of the planetary system revolving round the sun.

To reach this general theory is the ultimate object of modern geology. The discovery of the right method of proceeding in this attempt is of modern date; and all the most important steps of the advance towards this 'high point of knowledge' have been taken within the memory of the generation now passing away. If, as Sir John Herschel tells us ('Discourse on the Study of Natural Philosophy'), "geology, in the magnitude and sublimity of the objects of which it treats, undoubtedly ranks, in the scale of the sciences, next to astronomy," it owes this distinction to the fact that its modern cultivators have sought within the ranks of inductive science better methods of research and purer models of reasoning than those afforded by the treasures of ancient philosophy which have been preserved to our time. Nor is this the peculiar boast of geology. Every branch of the study of nature was equally transformed by the introduction of the Baconian methods of interpretation of nature; all the natural sciences have advanced together; the knowledge of the constant laws in the visible creation has been continually perfected; and thus, while the study of the long-past operations of nature has been imbued with the exactness of chemical, zoological, botanical, and physical research, the dry annals of one era in the history of the world have been enriched into a long, instructive, and eventful history.

Among the ancients the notices of geology are few, and the interest belonging to them is of a peculiar character. When chemistry, whose operations manifest the existence of peculiar laws of force among the particles of matter, was wholly unknown—when the living wonders of creation were but slightly considered by philosophers intent on abstract principles—no accurate survey could be taken of the condition of any one part of the surface of the earth. But a small part of that surface was known to any one people, and only in a few situations were the changes in the aspect of nature so extensive as to arrest the attention of the geographer, or so violent as to excite the philosopher to search for the cause.

Among the anciently peopled and commercial states of the eastern shores and islands of the Mediterranean both these circumstances concurred, and there first awakened the powerful intellect of Greece to speculation on the varying condition of the land and sea. Lower Egypt is the gift of the Nile, and the learned people which possessed it were compelled by the circumstances of their situation to study the nature and effects of the annual floods of the river. Herodotus (born B.C. 484) estimates (ii. 11) that the Nile, if diverted into the Red Sea, would fill that long gulf in less than 20,000 or even 10,000 years. The notion of change thus distinctly impressed upon the minds of the Egyptian priests was developed in a general and philosophical form, and illustrated by special references to an extended series of geological phenomena by their pupil Pythagoras (born B.C. 586). According to the summary of their doctrine, and the tenor of the illustrations of it which are given by Ovid, we cannot avoid seeing, even through the injurious ornament of verse, that Pythagoras had acquired a clear conception, a 'distinct idea,' of nature as existing by the concurrent action of many complicated powers, which were subject to continual or sudden variation in their relative intensity. Changes of the relative level of land and sea, and divulsion of islands from the mainland by the action of earthquakes, are distinctly announced; the displacement and limited duration of volcanic vents, such as Ætna; the degradation of land by the action of atmospheric agency ('et eluvie mons est deductus in æquor;') the submersion of land which had been formerly peopled—

> Si quæras Helicen et Burin, Achaidas urbes,
> Invenies sub aquis.—(Ovid, 'Metam.' xv., l. 293.)

the production of new land, and the occurrence of marine shells far from the present seas;—these phænomena, distinctly observed and analysed, and clearly produced in proof of a general proposition, justify a higher degree of admiration for the Samian philosopher than is due to any of the merely speculative writers of antiquity.

Similar observations appear to have served as the ground-work of Aristotle's exposition ('Meteorologica') of the perpetual fluctuation of natural phenomena; the alternate excitation and rest of parts of the earth's surface. But it is in Strabo that we find the most sensible views of the causes of the occurrence of marine shells far from the shore, the displacements of land and sea, the rising of islands, the formation of straits, and other great geological phenomena.

Having stated the views of Eratosthenes, as to the general fact of the earth's globular form, and the production of the numerous minor inequalities on its surface, by correspondingly numerous 'proximate causes,' such as the operations of water, heat, concussions, vapours, and the like, he examines the opinions of Xanthus and Straton, which Eratosthenes had preserved. (Strabo, Casaub. 49, &c.)

The explanation of Xanthus (derived from an historical fact) that the phenomena in question were due to great droughts which had diminished the originally greater expanse of the sea, is regarded as insufficient; and Strabo's hypothesis of adjacent but disconnected seas, one of which being raised to a higher level by sediment on its bed, had forcibly opened itself a passage to the other, the Euxine to the Propontis, the Mediterranean to the Atlantic, is shown to contradict received physical theorems. Strabo proposes to account for these and other phenomena by the general speculation that the land, not the sea, is subject to changes of level, and that such changes more easily happen to the land below the sea, 'because of its humidity.'

The action of Ætna in moving the shores of Sicily and Italy is spoken of in a familiar manner, and a long description of phenomena bearing on the discussions succeeds, in which the opinions of many authors are quoted.

Fifteen hundred years elapsed after the era of Strabo, without adding anything material to the stock of geological facts, or the limited range of rational theory; for, excepting the work of Omar (10th century), in which the phenomena of 'new lands,' and marine shells found inland, are referred to a 'retreat of the sea,' there is not, on the subject of geology among the Arabian writers, even the usual amount of comment on the writers of Greece and Rome which characterises the literary efforts of the learned Moslems. (Lyell, 'Principles of Geology.')

In modern times Italy, the fruitful mother of modern physical science, offered in her volcanic cones, ranges of mountains, and shelly marls at their bases, the most attractive points to the intellectual activity of the precursors and contemporaries of Galileo.

So recent are sound views of the true nature and relations of the organic forms buried in the earth, that it is not very difficult for English geologists to imagine the fierceness of the contest in which Fracastoro (1517) was involved, to defend his opinions that the 'formed stones' (as they were afterwards termed in England) were not 'lusus naturæ' produced by a 'plastic force,' but really the remains of fishes, mollusca, &c.; and that they had not been rudely scattered over the surface by the Noachian flood, but buried at great depths by a more regular operation of water. These important assertions were the subject of controversy for nearly two centuries in Italy; and in establishing the true nature of the organic remains, Cardano, Colonna (1666), and Scilla (1670) overlooked or disregarded the more serious and more seducing error of ascribing their inhumation in the earth to a general deluge. Georgius Agricola (1546) adopted the wrong view of the origin of organic fossils: but Steno (1669) of Copenhagen, opened a new line of inquiry, by noticing the succession of rocks; distinguishing some as having been formed before the creation of animals and plants; insisting on the original horizontal position of the strata; the proof of violent movement of the crust of the globe, afforded by the now inclined position of such strata in mountainous countries; and the variations of condition to which the surface of Tuscany had been exposed, by repeated overflows and retirements of the sea. (Lyell, 'Principles.')

Scilla's masterly work on the organic remains of Calabria, published both in Latin and Italian ('La Vana Speculazione disingannata dal Senso,' 1670), may be considered as closing the long dispute in Italy, among men of philosophical minds, on the subject of the nature of organic fossils. Its course was comparatively very short in England, for Plot (in 1677) is almost the only writer who really and heartily embraced the doctrine of an occult cause, to escape from the consequence of admitting the true origin of the 'formed stones,' and Scilla's work was abridged for the 'Philosophical Transactions' in 1695-6, by Dr. Wotton. Lister's early views on the matter (1678) express a doubt, arising from knowledge; he saw that the fossil-shells were different from the living types, and proposed the alternative of a terrigenous origin, or an extinction of species. Ray (1692) on 'Chaos and Creation,' Woodward's 'Natural History' (1695), Scheuchzer's 'Herbarium Diluvianum,' of the same date, afford proof of the victory gained by the observations of naturalists over the closet speculations of metaphysicians, on the origin of fossil-shells in most parts of Europe; and indeed, in France, Palissy's lectures and writings (his last publication bears the date of 1580) may be said to have established the truth contended for.

The victory was unproductive. In consequence of coupling with the obvious truth a fatal and fundamental error, the shells and other exuviæ of the sea were maintained by Woodward and a host of contemporaries and followers to have been brought upon the land by the 'universal deluge,' as all writers except Quirini (1676) agreed to term the Noachian flood. This error might speedily have been swept away by the early arguments of Palissy, the investigations of Steno, and the striking generalisation of Lister; but that, unhappily, from a philosophical question, it became a theological argument. The fossil-shells far from the sea were held to be physical proofs of the truth of the Mosaic narrative; and the occurrence of these shells at various depths and heights, and in rocks of different kinds, only furnished additional arguments in favour of the violence of that flood, which not merely was supposed to have covered the mountains, but to have entirely broken up and dissolved the whole frame-work of the earth, and to have deposited the materials according to their relative gravity. In vain had Hooke, Ramazzini, and Ray, previous to 1700, protested against the absurdity of this hypothesis, which Leibnitz appears to have despised; it was reserved for Moro (1740), Buffon (1749), Linnæus (1770), and Whitehurst (1792), to hasten its banishment from philosophy; but even at this day there are persons who from time to time revive the discussions of the 16th century, as a point of importance in Christian theology.

To account for the dryness and elevation of the countries where fossil shells occur, there are but two hypotheses: the shelly bed of the sea has been raised, or the ocean has abandoned its ancient place. Many of the Italian geologists adopted the former view, and in consequence repeated the opinions and reasonings of Strabo, with the advantage of referring to the elevation of Monte Nuovo near Puzzuoli, in 1538, and Santorino, 1707 (Majoli, 1597; Vallisneri, 1721; Lazzaro Moro, 1740). The better order of English writers (Hooke in 1668, Ray in 1692—earthquakes were then frequent in Europe) adopted the same views; and Hooke in particular presented the phenomena of earthquakes and volcanoes in the form of a general speculation, which served to direct the opinions of subsequent systematists like Whitehurst.

None of the philosophers who were concerned in establishing the truths connected with organic remains were seduced by their success into the vanity of proposing any general hypothesis on the formation of the earth. But this creditable modesty, so characteristic of the spirit of induction which animated Fracastoro, was not at all imitated by the fanciful diluvialists, who followed in the wake of Woodward, Burnet, Whiston, Catcott, and others. To determine whence came the water which held at once in suspension the whole of the exterior parts of the globe, and whither it retreated, was necessary to help out their extravagant proposition.

No ordinary hypothesis would meet these formidable problems, and if we recollect that in answering them it was further required to adopt views which should not trench on the arbitrary notions then entertained as to the meaning of certain passages of Scripture, we shall be disposed to regard even the monstrous violations of physical truth which appear in the hypothesis of Burnet, Woodward, and Whiston, without surprise. Omitting minor circumstances which it would be useless to particularise, Burnet, Woodward, and their followers, agreed in adopting the notion of an interior abyss below the crust of the earth, as the general reservoir from whence the waters rushed to cover the earth, and into which they again withdrew after the diluvial devastation was completed. Whiston, who was far better versed in physical science than either of the others, introduced in addition the notion of extraneous force; he brought a comet to envelop the earth in its misty tail, to cause violent rains, raise vast tides in the internal abyss, and thus effectually destroy the external crust of the planet. It appears probable that mankind seldom permit their imaginations to take such dangerous flights without necessity; the hypothesis is made to suit the conditions of the moment, and the chief error consisted in including among these conditions a narrow and unreasonable interpretation of the Mosaic narrative.

The diluvial hypothesis has been sufficiently traced to its natural consequence—a monstrous violation of the laws of nature; another general view, first distinctly stated by Vallisneri (1721), has been the source of long-continued errors. Struck by the general diffusion of marine fossils, he supposed the ocean to have once extended over all the earth, and to have gradually subsided, leaving everywhere the traces, not of a violent flood, but of the quiet super-fluctuation of water. Perhaps Vallisneri found this notion in his travels; at any rate, the notion of a universal subsidence of the ocean appears to be the German element of geological hypothesis, for Werner made it the basis of his so-called theory of the earth, and thus obscured with a physical improbability the important truths which he had established concerning the succession of strata.

Starting from an entirely different point, Leibnitz (in 1680) proposed one of the most general contemplations which has ever appeared in geology. He commences with the concentration of the mass of the globe in a state of great heat; accounts for the fundamental primary rocks by the refrigeration of the surface, and explains the violent action of water upon them by the collapse of this crust on the contracting nucleus. Sedimentary strata are the natural consequence of these watery movements subsiding to rest, and by the repetition of the phenomena such features are imparted to the earth as to insulate many of the later deposits, and render it necessary to be prudent in determining whether local or general agency has been concerned in producing them. It would be difficult in general terms more clearly to announce views now prevalent among those who contemplate geology in connection with physical science. Cordier, Von Buch, and De Beaumont have endeavoured by this speculation of Leibnitz to explain some of the principal phenomena of geology—the elevation of mountains; but the merit of Leibnitz's theoretical views was little regarded in England till Mr. Conybeare explained his views to the British Association at Oxford at its first meeting in that city in 1833.

The effect of Laplace's and Fourier's theorems on the operation of interior heat have been augmented by Mr. Hopkins's labours; and the grand views of Sir W. Herschel as to the constitution of the universe have been applied to the history of the earth by Sir Henry De la Beche.

In the works of Ray (1692), and Hooke (1688), we may trace the revival of another general speculation (that of Pythagoras), which, instead of deducing the leading geological appearances from some primal condition, with Leibnitz, supposes the essential condition of the world to be one of continual change, and assigns to modern causes in action a measure of force capable of producing, in a sufficient lapse of time, phenomena as important as those of ancient geological date.

Lazzaro Moro's views (1740) have the same tendency to recall speculation to the enployment of real causes seen in daily operation; Buffon (1749) appears to have unsuccessfully attempted the union of the fundamental view of Leibnitz and the regard for existing agencies shown by Ray; Dr. James Hutton, of Edinburgh, rejected all inquiry as to the beginning of the world, and gave himself up entirely to an explanation of the phenomena visible in the crust of the earth, on the principle of a continual degradation of land by atmospheric agency, the consequent formation of sedimentary strata on the bed of the sea, and the periodical compensation of these effects by the action of internal heat raising the bed of the sea, with the stratified deposits thereon. A continual destruction of the existing land through the agency of water, and an occasional uplifting of new continents from the ocean bed—these are the most striking points of the Huttonian theory of the earth. Sir Charles Lyell differs from Dr. Hutton chiefly by recurring to the original form of the speculation as we may conceive it to have existed in the mind of Pythagoras or Aristotle, could either of those men have become acquainted with modern science. For, instead of the occasional occurrence of a violent upward movement of the bed of the sea, the author of the 'Principles of Geology,' contends for a continual compensation among the agencies of nature, the perfect equality of modern and ancient physical forces, and the possibility of explaining all, even the grandest, of ancient geological phenomena by causes now acting, and acting with their present intensity. No more definite or general proposition has ever been advanced in geology, and its effects have been everywhere evident in the advancement of geological science.

Geological appearances are usually of a complicated character, and must be analysed into their elementary parts before the inductive process, which requires the comparison of facts agreeing or differing with respect to a certain quality, can be usefully applied. Fossil shells must be distinguished into fluviatile or marine, identical with or different from recent kinds; rocks must be considered as to their chemical nature, mechanical structure, geographical and other characters, before any valuable inferences can be gathered from them. Though this kind of labour is not discoverable among the works of the Greeks which remain to us, we must not hastily deny that they attempted it. In modern times Fracastoro, Palissy, and Steno, by distinguishing the groups of strata; Lister, by discriminating recent and fossil species of shells, and by noticing the geographical relations of rocks; Woodward, by his industrious collection of specimens and methods of arrangement; Packe, by his remarkable chorographical map of Kent; Lehman (1756) and Arduino, by their classification of rocks, according to the relative periods of their production; and Mitchell (1760), by his masterly determinations concerning the relation between the ranges of mountains and the inclinations of the neighbouring strata—have stronger claims to grateful remembrance than are due to those who with much labour have merely produced volumes of empty speculation.

John Gottlob Lehman (1756) may be considered as having the best claim to a clear enunciation and proof of the different age and relative position of classes of stratified rocks. In the French translation of his work ('Traité du Physique, d'Histoire Naturelle, de Mineralogie, et de Metallurgie') he says, "Nothing is more natural than to group all mountains in three classes. The first includes mountains which are coeval with the formation of the globe; the second class was produced by a revolution co-extensive with its surface; the third consists of mountains which owe their origin to particular accidents or local revolutions." This was not a mere speculation of what might be convenient, for he adds, "The mountains of the first class are high, sometimes insulated in the plains, but generally connected in a chain, traversing considerable parts of the earth. They differ from those of the second class by their elevation and extent, by their interior structure, by the mineral substances associated with them."

Pallas ('Journal de Physique,' 1779), in addition to these general views, maintains that the granitic rocks, then taken as primary, were never formed by water, because they do not occur in beds, nor contain organic remains; that the secondary mountains were produced from the disintegration of granite; and the strata of later date, by the wrecks of the sea elevated and transported by volcanic eruptions and subsequent inundations.

To these distinguished authors Werner, professor of mineralogy in Freyberg (1775), was a worthy successor. The first important addition made by him to our previous knowledge on the subject was contained in his 'Kürze Klassifikation und Beschreibung der verschiedenen Gebirgsarten' (1787), where the mineralogical distinctions of rocks may be viewed as a completion of the labours of the earlier Swedish writers, Cronstadt, Wallerius, Linnæus, &c., all of whom had glimpses of the geological relations of the rocks they classified. It does not appear that Werner proposed any views as to the geological relations of rocks in advance of those of Lehman or Pallas till 1790 or 1791, when the doctrine of 'formations' was explained in his lectures, which indeed was a powerful mode of diffusing instruction; for his amiable manners, disinterested enthusiasm, and various knowledge gave him a strong ascendency over the numerous pupils who, from various countries, flocked to Freyberg. In 1795 Werner had matured his views as to the classification of all the stratified rocks, and from this it is easy to estimate the real claim of Werner to a high place in the ranks of modern geology. The great advance made by Werner consists not in propounding the distinctions of great classes of rocks, for this had become a common idea in Europe, but in practically analysing these classes into their constitutent groups, tracing the order of succession among them, assigning their mineralogical characters to each, and generalising this local truth into the doctrine of formations universally succeeding one another in a settled order of time. Parting from Freyberg with a better method of mineralogy, and a more developed system of the succession of rocks than was previously known, the pupils of Werner carried the influence of his name and opinions over the world, and, unfortunately, the crude hypothesis which was connected with the rich truths he taught was embraced with an ardour very disproportionate to its value.

In France Rouelle (about 1760) had acquired ideas apparently as general, and fully as well supported by local knowledge, as Lehman. His views on organic remains were quite in advance of the time. In England the notices of stratification by Mr. Strachey ('Phil. Trans.,' 1719), the Rev. B. Holloway (1723), and the Rev. John Mitchell (1760) are of great importance. Strachey presents an accurate section of the coal strata of Somersetshire, with reflections on the strata above them, and their geographical boundaries; Holloway describes the geographical relation of the sand-hills of Woburn and Shotover, yielding fullers'-earth, to the chalk hills on the east, and the oolitic tracts on the west; but Mitchell enters into a general and masterly discussion on the relation between geological structure and the geographical features of the surface not to be paralleled for fully fifty years.

Whitehurst must here be mentioned with honour. His 'Inquiry into the Original State and Formation of the Earth,' 1778, is of small value for the purpose he proposed, but it contains important facts towards a right conception of the structure of the earth. His 16th chapter, entitled 'The Strata of Derbyshire and other parts of England,' is full of information, principally derived from the miners, but evidently well methodised in his own mind. How could the geologists of England neglect such passages as these following, which are merely the scientific exposition of truths known for hundreds of years previous by skilful miners in all regions of stratified rocks?—"The arrangement of the strata in general is such that they invariably follow each other, as it were, in alphabetical order, or as a series of numbers, whatever may be their different denominations. Not that the strata are alike in all the different regions of the earth, either with respect to thickness or quality, for experience shows the contrary; but that the order of the strata in each particular part, how much soever they may differ as to quality, yet follow each other in a regular succession, both as to thickness and quality—insomuch that by knowing the incumbent stratum, together with the arrangement thereof in any particular part of the earth, we come to a perfect knowledge of all the inferior beds, so far as they have been previously discovered in the adjacent country." (Edit. of 1792, pp. 178, 179.) In p. 186 is the following remark in capitals:—"N.B. No vegetable forms have yet been discovered in any of the limestone strata."

From these notices it is very clear that a distinct perception of a fixed order in the succession of strata was so prevalent in the mining districts of England as to attract the attention of the well-informed classes of society. But it is extraordinary that Mitchell, who was appointed Woodwardian professor in 1792 (according to Farey), and by his physical and mathematical knowledge seemed especially able to work out the whole system of English stratification, should, on his retirement from Cambridge to his rectory of Thornhill in Yorkshire, have contented himself with tracing the succession of strata in the north of England, or rather between Cambridge and Thornhill, and communicating the document to Smeaton, without giving it even to the Royal Society, which had published his early papers. Had this been done, or had Smeaton known the value of the paper put into his hands, it could not have happened, that of all the able engineers who before 1790 were engaged in surveys and executing canals, not a man should have attended to information of such singular value in his profession; nor would Dr. William Smith have been occupied in re-discovering some of the truths which constitute the foundation of English geology.

The progress of Dr. Smith's discoveries in geology is easily traced. Commencing his career as a surveyor of land, and afterwards acquiring great employment as a civil engineer, his attention was drawn in 1787 to the obvious distinctions in the soils and the subjacent strata of certain parts of Oxfordshire and Warwickshire, which occupied, with regard to one another, a certain geographical relation. In 1790 and 1791 the same relative position of the same strata was forced on his attention in Somersetshire, with the addition of a series of coal strata below the oolite, lias, and red marls with which he was previously familiar. Assured by his own observation that the local knowledge of the mines of Somersetshire which Strachey had published in 1719 was only a part of the truth, he set himself not to frame a hypothesis, but to determine the extent of the regular succession of strata in the vicinity of Bath, drew accurate sections of the strata in the order of superposition, ascertained amongst them a general dip to the east, marked their ranges on a map of the surface, and in 1794, in the course of a professional journey from Bath into the north of England, examined impartially whether the general features of stratification in other parts of England corresponded with the impression fixed in his mind by abundant evidence, near Bath, that one general order of succession of the strata could be traced throughout the island, with a general dip to the east or south-east. The result confirmed his view, and excited him to devote time, professional income, and unequalled labour to produce proof satisfactory to others. The result was a geological map of England and Wales, drawn previous to 1801, when proposals were issued for the publication of it.

The strong conviction in his mind of the regular, orderly, and successive deposition of the strata, led him to a more minute analysis of the characteristic marks of the several deposits than had ever been conceived before. The remarkable resemblance and occasional proximity of many rocks near Bath, belonging to different places in the section of strata, and which (to use a favourite expression of Dr. Smith) "had been successively the bed of the sea," prevented any merely mineral distinction from being effectual; and he was thus forced to study with care the method of distribution of the fossil organic remains in the rocks for the purpose of discriminating these similar deposits. This was not long pursued before the local peculiarities of the strata in this respect were connected to a general law; and it was found that throughout the district in question the fossils were definitely located in the rocks; each stratum had its own peculiar species, wherever it occurred, and could thus be identified when in detached masses and in distant localities. This great discovery was recorded as a thing fully determined in a table of the Order of Strata in 1799, of which copies were distributed beyond the British Islands. The clear idea of each stratum being successively the bed of the sea is apparently the germ of that happy expansion of geological truths, unmixed with hypothesis and unfettered by a formula of merely local stratification, for which English geology is indebted to Dr. Smith. Such an idea immediately suggests, not a speculation in cosmogony, but various yet harmonious researches in the full spirit of inductive science. The history of successive geological periods, all characterisable by their chemical or mechanical products and contemporaneous organic existence, was thus placed in a concentrated light as a general problem for inquiry, and the effects were immediately obvious in the employment of organic remains, and sections and maps of strata, to determine the true condition of the land and sea from the earliest periods to the present hour.

Against the hypothesis of Woodward, that the fossil exuviæ in the rocks were lodged in them by the 'universal deluge,' it was objected, that though the fossil shells, corals, fish-teeth, &c., resembled the recent kinds, they were not the same. The question thus raised could not rest. Lister affirmed that in general the fossil species of shells were entirely distinct from living forms; Camerarius inquired to what marine genus of animals Woodward referred the belemnites, and received for reply that it was a mere mineral! The ammonites were admitted to be not nautili, but were declared to be 'Pelagian shells' not likely to be thrown on the present sea-coasts by the moderate force of tides and storms, which do not influence the deep parts of the ocean. Linnæus continually points out the species of corals and shells to which no recent analogue is known; and Solander, by giving suitable names to the extinct shells of Hordwell Cliff, figured by Brander (1766), opened the way to the researches of Martin, Parkinson, Sowerby, Brocchi, Deshayes, Goldfuss, and more modern writers.

Llwyd and Scheuchzer commenced the study of fossil plants, which has lately been so much advanced by Sternberg, Adolphe Brongniart, Lindley, and Joseph Hooker. But by none of those writers who compared the fossil and recent worlds of life under the aspects of zoology and botany only could any clear notion be formed of the existence and destruction of a succession of different races of animals and plants. Lister had noticed the constant occurrence of a certain belemnite in the red layers at the base of the chalk; Morton had distinguished the geological position of some fossils in Northamptonshire; and Llwyd and Woodward had some knowledge of this kind. Rouelle and Werner have claims to attention, but certainly it is to Dr. William Smith that we owe the introduction of the important doctrine, that during the formation of the stratified crust of the earth, the races of animals and plants were often and completely changed, so that each stratified rock became in his eyes the museum of that age of the world, containing a peculiar suite of organic exuviæ, the remains of the creatures then in existence.

In France the same truth was put in a bright light by the successful labours of Cuvier and Alex. Brongniart in the vicinity of Paris; the former of whom, by his great anatomical skill, succeeded in restoring the vanished forms of many quadrupeds, different from those which now live; while the latter, collecting materials with great judgment from a wide field of research, brought the most convincing proof of the almost total dissimilitude between the forms of life of the secondary and tertiary periods of geology, while both were for the most part distinct from those of the actual land and sea.

The general doctrine of many successive creations of life in the globe, thus firmly established in England and France, was speedily acknowledged in every country where accurate observations could be made, and it only remained to trace out its consequences, and apply them to particular problems. One very successful effort of this kind has been made by M. Deshayes and Sir Charles Lyell, who, observing among a vast number of the tertiary fossil shells which are different from existing types, some few of which are identical with them, proposed to determine what variation there might be in the proportion of yet existing species among the tertiary fossils from different localities and deposits of a different geological age. As a general result (subject to exceptions) it may be stated, that the more recent the strata the greater the amount of resemblance between their fossil contents and the existing creation—a result in harmony with general views of the whole subject of the analogy of recent and fossil forms. Hence arises a method of classification for these strata of peculiar interest and power, though its successful application may for a time be delayed, till the philosophy of organic remains be more perfectly developed.

Without maps and sections of particular districts, representing the extent, thickness, and order of superposition of the several component rocks, the abstract truths of geology could never become of general interest or public value. Until the whole of the land be thus surveyed and described geological inferences may be insecure; it is therefore gratifying to reflect, that since Dr. Smith first proposed to publish a geological map of England (1801), a considerable part of Europe has been thus delineated. The first idea of such a map was given by Lister in a communication to the Royal Society in 1683; Mitchell's descriptions in 1760 are such as to make it surprising that no map came from his hands. The Wernerian school of geognosy produced none, we believe, so early as those few maps of the Board of Agriculture in England (1794), which contained delineations of soils, and occasionally of the rocks which gave them their distinctive qualities. In this respect Dr. Smith had no precursor; and when his map of the strata of England and Wales was produced, in 1815, it had no rival. Since this time maps of England have been published by Greenough, Phillips, Murchison, Knipe, and others. The geological survey of Great Britain is also going on. Mr. Griffith has published a map of Ireland; Dr. M'Culloch a map of Scotland; Von Buch's great map of Germany is published; the Mining Engineers of France are completing their survey of that country; the United States of America have made great progress in a similar labour; and the number of topographical works illustrated by maps and sections is innumerable. Before many years have passed, the whole accessible surface of the land will have been mapped by geologists.

We may conclude this historical sketch of the progress of geology with the following remarks from Sir Charles Lyell's 'Principles of Geology:—

"A distinguished modern writer has with truth remarked, that the advancement of three of the main divisions of geological inquiry have during the last half century been promoted successively by three different nations of Europe — the Germans, the English, and the French. We have seen that the systematic study of what may be called Mineralogical Geology had its origin and chief point of activity in Germany, where Werner first described with precision the mineral characters of rocks. The classification of the secondary formations, each marked by their peculiar fossils, belongs in a great measure to England, where the labours, before alluded to, of Smith, and those of the most active members of the Geological Society of London, were steadily directed to these objects. The foundation of the third branch, that relating to the tertiary formations, was laid in France by the splendid work of Cuvier and Brongniart, published in 1808, 'On the Mineral Geography and Organic Remains of the Neighbourhood of Paris.' We may still trace in the language of the science, and our present methods of arrangement, the various countries where the growth of these several departments of geology was at different times promoted. Many names of simple minerals and rocks remain to this day German, while the European divisions of the secondary strata are in great part English, and are indeed often founded too exclusively on English types. Lastly, the subdivisions first established of the succession of strata in the Paris basin have served as normal groups to which other tertiary deposits throughout Europe have been compared, even in cases where this standard was wholly inapplicable. No period could have been more fortunate for the discovery, in the immediate neighbourhood of Paris, of a rich store of well-preserved fossils, than the commencement of the present century; for at no former era had Natural History been cultivated with such enthusiasm in the French metropolis. The labours of Cuvier in comparative osteology, and of Lamarck in recent and fossil shells, had raised these departments of study to a rank of which they had never previously been deemed susceptible. Their investigations had eventually a powerful effect in dispelling the illusion which had long prevailed concerning the absence of analogy between the ancient and modern state of our planet. A close comparison of the recent and fossil species, and the inferences drawn in regard to their habits, accustomed the geologist to contemplate the earth as having been at successive periods the dwelling-place of animals and plants of different races, some terrestrial and others aquatic, some fitted to live in seas, others in the waters of lakes and rivers.

"By the consideration of these topics, the mind was slowly and insensibly withdrawn from imaginary pictures of catastrophes and chaotic confusion, such as haunted the imagination of the early cosmogonists. Numerous proofs were discovered of the tranquil deposition of sedimentary matter, and the slow development of organic life. If many writers, and Cuvier himself in the number, still continued to maintain that 'the thread of induction was broken,' yet in reasoning by the strict rules of induction from recent to fossil species, they in a great measure disclaimed the dogma which in theory they professed. The adoption of the same generic, and in some cases even of the same specific, names for the exuviæ of fossil animals and their living analogues, was an important step towards familiarising the mind with the idea of the identity and unity of the system in distant eras. It was an acknowledgment, as it were, that part at least of the ancient memorials of nature were written in a living language. The growing importance then of the natural history of organic remains may be pointed out as the characteristic feature of the progress of the science during the present century. This branch of knowledge has already become an instrument of great utility in geological classification, and is continuing daily to unfold new data for grand and enlarged views respecting the former changes of the earth. When we compare the result of observations in the last fifty years with those of the three preceding centuries, we cannot but look forward with the most sanguine expectations to the degree of excellence to which geology may be carried, even by the labours of the present generation. Never perhaps did any science, with the exception of astronomy, unfold in an equally brief period so many novel and unexpected truths, and overturn so many preconceived opinions. The senses had for ages declared the world to be at rest, until the astronomer taught that it was carried through space with inconceivable rapidity. In like manner was the surface of this planet regarded as having remained unaltered since its creation, until the geologist proved that it had been the theatre of reiterated change, and was still the subject of slow but never-ending fluctuations. The discovery of other systems in the boundless regions of space was the triumph of astronomy to trace the same system through various transformations—to behold it at successive eras adorned with different hills and valleys, lakes and seas, and peopled with new inhabitants, was the delightful meed of geological research. By the geometer were measured the regions of space and the relative distances of the heavenly bodies—by the geologist myriads of ages were reckoned, not by arithmetical computation, but by a train of physical events—signs which convey to our minds more definite ideas than figures can do of the immensity of time."

Geology is distinct from cosmogony. The history of the successive phenomena happening on a planet revolving round an orb of light and heat may be treated without reference to the condition of the same material particles while they were subject to entirely different conditions. Yet as in tracing the progress of a colony reference may often be made with advantage to the previous history of the same people in another region of the globe, so, in prosecuting geological science in a just and liberal sense, it is advisable to take into account the discoveries of collateral science, so far as these tend to give sure indications of, or even to fix certain limits to, speculations concerning the origin of the planetary masses.

For the successful prosecution of this inquiry geology must appeal to two entirely distinct branches of collateral science, chemistry, and astronomy; which indeed agree in this, that they are both directed to the elucidation of the properties of material substance; but the former is occupied with a study of its elementary constitution, the latter contemplates the relations of its congregated masses.

Chemistry, by analysis of the different sorts of matter visible near the surface of the earth, teaches us that almost everything is of a compound nature, and formed by the union of two or more elementary particles, endowed with distinguishable properties, and capable of a separate existence and of entering into new combinations. When thus freed from their combinations by processes of art the elementary particles or atoms, of the same kind, form, when reunited, solids, liquids, or gaseous expansions, according as they are affected by temperature, pressure, and perhaps other less general influences. Oxygen, the most abundant of all the elementary substances yet discovered, expands immediately on being freed from union with solid bodies, to a gas which occupies 2000 times the space it previously did; and as nearly half the ponderable matter of the globe consists of oxygen, we must admit, as a plain consequence of this analysis, that upon a general resolution of the compound rocks and minerals into their constituent elements, nearly half the weight of the exterior parts of the globe would expand into gas, and augment the atmosphere till the accumulated pressure should liquify the gas, or prevent further decomposition. What happens to free oxygen with the temperatures and atmospheric pressures which now prevail at the surface, would (we know by trial) happen to chlorine and other substances similarly released from combination, under other temperatures and pressures. As these conditions are now variable, and may be supposed to have passed through all possible grades, it is not improbable that all the substances which exist in the crust of the globe might be converted into gaseous expansions if freed from combination. The great antagonist force to the concentration of matter is heat; by augmenting this agent some substances are decomposed and the parts rendered volatile; in other cases combinations take place which are also volatile; and there are others in which gaseous substances combine with solids at particular temperatures only. Now, as the substances known in the outer parts of the globe are about 60 in number, as they all separately stand in different relations to heat, pressure, electricity, &c., it is conceivable that under particular conditions the mutual forces of the various particles might be so arranged, and so balanced by the influences of heat and other general conditions, that all sensible solidity and liquidity should vanish, and the whole globe dissolve into an expansion, where the particles would be, if not all free, yet in very different combinations from those we now see. This is conceivable as an hypothesis, and chemistry can teach us no more; for as we have not ascertained for each substance, taken singly, what must be the conditions for its appearance as a solid, liquid, or gaseous body, nor have the means of computing what variation in this respect might result from particular admixtures of the substances, it is impossible to deny that the hypothesis may be true, and it would be equally unphilosophical to assert that it is. In this dilemma we must turn to the contemplation of phenomena which may serve to guide us to a just decision. Omitting for the present all considerations of geological phenomena, we must accompany the astronomer in his survey of space, in order to discover if any masses of matter exist which are of the nature of the gaseous expansion assumed; if this be the case, we must further inquire if there be gradations in the appearances they present such as to justify the belief in the possibility of a gradual conversion of a planet into an expansion, or the contrary. To these inquiries the far-seeing eyes of Herschel supply a positive answer. Through various parts of the heavens are scattered large expansions of attenuated matter, called nebulæ, which are irregularly reflective of light, various in figure and degree of condensation. The latter circumstances being carefully studied, it appears that many of them are of a globular or elliptical figure, as if the parts were collected by a general attraction toward a centre; that others in addition, appear to grow continually denser toward a centre, while not a few objects show in the centre the brightness of a solid star surrounded by a thick and extensive haze. Occasionally two or more points of condensation appear in a nebulous mass, thus affording a great analogy with what may be supposed to be the origin of our planetary system.

Comets, which are to be regarded as nebulæ attracted to some one or more systems, supply another and strong analogy with orbitual planets. But it may be reasonably expected that in addition to the graduated appearances of expansion, condensation, and nebulous solidity, there should be proof of corresponding gradations of density. This proof, as far as relates to the nebulæ far distant from our system, can perhaps never be given, though appearances are in favour of the view; even with respect to the comets which enter the solar system, further researches must be made; but the planets themselves supply such a proof, for their density varies exceedingly. The planets nearer to the sun are denser than those farther removed; Mercury, being the heaviest, is almost thrice as dense as the earth, while Jupiter, one of the distant orbs, is about one-third as dense as our earth; and Saturn, which, excepting Uranus, is the most remote, is only one-eighth or one-tenth as dense, and may be considered as light as cork. (Herschel, 'Introduc. to Astron.,' p. 278.)

Finally, this general idea of the origin of the mass of the earth from a nebular expansion, suggested by chemical facts, and supported by the appearances in the visible heavens, is confirmed by the mathematical researches of Laplace, who has by this supposition connected together the most striking phenomena of the solar system; the general parallelism of the orbits of the planets, the consentaneous direction of their movement round the sun, of the satellites round the planets, the anomaly of Saturn's ring, and other important circumstances. We have therefore only one test more to which the hypothesis can be subjected, namely, its accordance with what is known of the actual constitution of the earth. This is still no question of geology, but of astronomy. It appears however very certain that neither the figure of the earth, which is that of a spheroid of revolution on its axis, nor the density of the earth, which is greater toward the centre than at the circumference, and so arranged that the surfaces of equal density are symmetrical to the axis of figure, are at all opposed to the doctrine in question, but rather confirm it. From astronomical and chemical considerations, then, it is probable that the mass of the earth once existed as a part of a diffused nebula, like some now visible in the heavens; and as no merely geological evidence as to the changes operated on the condensed planet can be of the smallest value in a question relating to the condensation of a nebula, we must adopt the conclusion as a limiting condition of geological theory.

But however firmly we may admit the truth of the speculation of the condensation of planets from a nebular expansion, it can now have but little influence on the progress of geology. For it cannot be employed as the origin of deductions which might disclose circumstances hidden from observation in deep parts of the earth, and explain complicated facts visible at the surface; and this for want of adequate knowledge of the successive effects which must happen among the elementary particles or masses of a nebula during its condensation, as well as of the necessary consequences which such effects must entail on the physical conditions of a planet.

There is however one point of importance which this speculation, if adopted, may assure us of. The condensation of nebulæ is gradual; the density of planets various the larger ones in general having the least relative weight; the earth must therefore be supposed to have passed through a long range of condensation; and this implies a continual change of intensity among some at least of the physical agencies which belong to it. Whatever was the antagonist force to the central attraction of the nebular mass, the gradual decline of this force must have been felt, more or less, by all the natural agencies related to it by opposition or sympathy. Even the extraneous influence of light is not independent of the change of conditions produced.

The continual condensation of the mass of a planet necessarily brings with it a change in the relative intensities of the agencies at work among its parts, because they operate under continually varying conditions. Some would lose and others gain in strength, and thus the aspect of the earth must have been continually changing, or subject to periodical renovation. By those geologists who accept the doctrine of the earth's continual condensation, from whatever cause, the uniform intensity of natural agencies taken separately, the continual compensation of their antagonistic effects, and the production of equal effects in equal times, must inevitably be rejected.

Yet though, in strictness, the preceding reasoning forbids assent to Sir Charles Lyell's general principle, that the former changes of the earth's surface "are referrible to causes now in operation," it by no means follows that other causes (that is, other combinations or measures of natural agencies) than those now in operation must be appealed to for explaining the monuments of past revolutions of nature which are preserved to our days. For if these monuments go but a short way back on the scale of time, compared with the periods which elapsed in the condensation of our planet, the causes may not have sensibly varied during the whole course of phenomena traceable in the crust of the earth. This must be decided by a study of the monuments themselves, upon the general and acknowledged principle that effects are proportional to the causes. Still less is it to be imagined that the study of the effects of modern causes in action is unfruitful in illustrations of the phenomena due to ancient causes; on the contrary, there is no other way of learning either the kind or degree of physical agencies concerned in geological operations of early date than the comparison of these with the results of the daily action of the modern powers of nature.

The knowledge of the condition of the earth with respect to temperature is one of the most important steps which can be taken toward a right general contemplation of the history of the revolutions which it has undergone. This knowledge cannot be gathered by geologists labouring as such; it cannot be obtained by meteorological observations, however accurate; nothing short of a mathematical theory of heat, supported by a variety of data concerning the physical constitution and relations of the earth to the sun and space, will be at all available in grappling with the inherent difficulties of the subject. For this theory we are indebted to Fourier.

The heat of any point on the surface of the earth regularly varies, from hour to hour, with the rotation of the globular mass on its axis; from day to day and from season to season, with its revolution round the sun; and from year to year, with any change in the dimensions or form of the earth's orbit. There are however several causes of irregularity or fluctuation of temperature not demanding notice in a general view.

If in its long course round the sun the earth passed through parts of the planetary spaces of unequal temperature, this would cause a modification of the periodical, annual, and daily variations.

The atmosphere and the ocean by their various movements modify all these circumstances, but not so as to disguise the results when an average of many periods is taken.

In consequence there is for each point of the earth's surface a certain mean temperature, depending on the causes above stated; and the parts under the surface continually tend to acquire very nearly the same temperature as the surface, but not at the same time. The extremes of summer heat and winter cold are not felt till after they have passed away from the surface; and in proportion as we descend, the influence of the daily, monthly, and annual variations grows less and less, because of the slowness of the conduction of heat through earthy substances.

At a certain depth below the surface these variations become wholly insensible, and the temperature is constant, and nearly the same as the mean temperature of the surface.

If the temperature of the interior parts of the earth be now very different from that constant heat which would result by communication from the surface (heated as before, and subject to the stated variations), this difference would exercise a corresponding though insensible effect on the surface heat, and be more or less sensible at small depths below the inner surface of constant temperature.

Whatever may have been the proper or original temperature of the inner parts of the earth, it is easy to conceive that in a very long time the equilibrium of heat should be reached, and the earth receive from the sun and radiate into the ethereal space equal quantities of heat in equal times; while the temperatures at points situated at very great depths below the surface (many miles, for instance) would not sensibly vary from that of the mean heat of the place vertically above them.

But if this equilibrium be not attained, the original state of the earth as to heat may be ascertained, so far as to determine positively whether it has formerly been hotter or colder than at present, by merely trying at many points exempt from volcanic action, what is the amount of heat at various depths, on the same or different vertical lines, as compared with the corresponding points of surface.

These trials have been made at various depths, under different circumstances, in salt-pits, coal-works, and mines of different metals, in the British Isles, France, Germany, Mexico; and in all situations where the external influence of the air and the artificial effects of light, respiration, &c., could be guarded against or justly appreciated, they agree in proving that after descending below the limit of variable heat, a continual augmentation of temperature constantly occurs. (1° Fahrenheit for 15 yards is a common ratio.) The mine of Fahlun, supposed to be an exception to this general truth, is extremely ill-suited for experiments. (See Thomson's and Clarke's 'Travels in Sweden.')

The consequence is obvious. The interior masses of the globe are incomparably hotter than the parts at the surface; must formerly have been still hotter; and though now the interior heat is almost wholly masked and stifled by the non-conducting stratified masses which form the crust of the earth, it must formerly have influenced in a decided manner the temperature, and with it all other phenomena at the surface of the earth.

The same conclusion as to the existence of great heat in the central parts of the earth has been drawn from considerations of the density of the interior masses as compared to the superficial parts. While the surface rocks are twice and a half as heavy as water, the mean density of the whole globe is five times as great as that of water; moreover the density augments towards the centre with so much of regularity, that the imaginary interior surfaces of equal density are symmetrical to the same centre and axis as those of the exterior spheroid. (Conybeare's 'Report on Geology to British Association,' 1832.) Now, if the interior masses of the earth are compressible even to a far less extent than the rocks near the earth's surface, the pressure to the centre would have made the inner parts much more dense than they are: the whole mass of the earth would have been included in a much smaller volume were it not for some antagonistic force, such as heat is known to be. Unless therefore we venture to suppose the central and surface matter not subject to similar laws of force, it must be admitted that the interior parts of the earth are still very hot.

This great truth established, we may inquire further into the state of the interior masses. If the heat of the globe were increased its diameter would be augmented; there is a degree of heat which would liquefy nearly all the substances of which it consists, taken singly, and still more easily when in their usual combinations. Beyond this degree of heat gaseous compounds would mix with or altogether replace the liquid rocks, and the globe would be lost in a nebulous expansion.

Turning to observations of phenomena, we find the interior rocks to be such as were cooled from igneous fusion: they are extensively, perhaps universally, spread below our feet; and thus we gather the conviction that originally the whole or great part of the exterior masses of the planet were in a melted state. The figure of the earth is such as would result from revolution on its axis, provided the whole or a very large part of the mass were in a state of fluidity or viscidity; to this figure the surfaces of equal density correspond both as to centre and axis; and thus strongly corroborate the speculations of Leibnitz, that the earth is to be looked on as a heated and fluid globe, cooled and still cooling at the surface by radiation of its superabundant heat into space.

To determine whether it is now solid or partially fluid within is a problem of high interest, and one which we may perhaps despair to see completely solved, unless certain astronomical phenomena (precession, nutation) should be found, when analysed by a rigorous mathematical deduction, to furnish interpretations which geology alone can never attain to. As however Mr. Hopkins has presented some simple views of the possible conditions of a cooling globe (as the earth may be considered), we shall here briefly state them.

If the earth were originally a hot fluid mass cooled by radiation, the cooled parts would descend towards the centre, and be replaced by others in a perpetual circulation. The tendency to solidification in such a mass would be directly as the pressure, inversely as the temperature, both which are at a maximum at the centre: solidification would therefore be determined near the centre by the superiority of pressure over temperature; and at the surface by the rapidity of external refrigeration overbalancing the internal conduction of heat. The numerical relations of these qualities are unknown. It cannot therefore be decided by mere calculation whether the solidification of the surface by radiation would precede or follow that of the centre by pressure. Let us suppose, for simplicity, the relations of pressure, heat, circulation, conduction, and radiation to be such that all the mass goes on cooling till every part of its fluidity is lost, and the whole is reduced to such a degree of viscidity as to prevent the circulation of heated matter, the further distribution of heat must, under these conditions, be determined by conduction and radiation only; a large part of the interior would assume equality of temperature: the solidification of the surface by cooling would be the first new phenomenon, to be immediately followed by condensation through pressure about the centre; and thus two solid masses would be produced and continually augmented—a spherical nucleus, and a spherical shell—while between them would remain a large but diminishing zone of viscous matter, subject to some changes of temperature through the conversion of its surfaces from a liquid to a solid state.

If, on the other hand, the effect of pressure to the centre became superior to the expanding agency of heat, before the circulation of liquid matter had ceased in the superficial parts, the centre would solidify first; and the induration might proceed through a large part of the globe, so as even to approach the surface before that could be consolidated. If these conditions were reversed, consolidation might proceed from the surface downwards, and would ultimately reach the centre, and the whole mass be a stony globe.

It is important to remark that upon neither of these suppositions is it required to admit the continual augmentation of heat to the centre; to which M. Poisson objected, and instead of which he proposed to account for the phenomena of the earth's interior temperature, by supposing that the solar system had once passed through other ethereal spaces than those which it now occupies, and there experienced much higher temperature at the surfaces of the planets. This hypothesis may be perhaps not very different in its development from the more general theory of the nebulous origin of the planets; but it appears unnecessary to discuss the speculation after what has been said of the cooling of the earth.

We may now proceed to examine the modern causes of changes on the surface of the earth. The never-ceasing activity of the powers of nature may be viewed as an inextinguishable and unavailing effort to restore an equilibrium which is incessantly disturbed. The protean changes of the atmosphere; the varying effects which its chemical and mechanical energies occasion among the masses of dead matter and the forms of life; the flowing of the ocean; the subterranean fire and wide wasting of the earthquake, are all efforts to obtain rest consequent on a succession of perturbations. In this sense, not the earth only, but all the solar system, and perhaps all the extent of the heavenly spaces, conceivable rather than visible by man, is in the condition of instability described in the Pythagorean Philosophy, "Nihil est toto quod perstet in orbe."

These changes on the surface of the earth affect the geographical boundaries of land and water, the relative level of land and sea, and the forms, proportions, and distribution of animal and vegetable life. In a popular sense they may be classed by their proximate agencies, as depending on chemical and mechanical powers originating from atmospheric action, rains, springs, rivers, &c.; as depending on similar powers residing in the ocean; and as affected by volcanic forces. We may also venture to contrast the effects of the watery agencies, whether of atmospheric or oceanic origin, with the products of volcanic fires. For the general effect of the watery agencies is to abate the high and to raise the low, to equalise the level of land and sea by abrading the former and filling the latter; but volcanic effects are directly the reverse. They augment the original inequality of the surface; in some parts they raise matter from within the earth, and form new hills to bear the ravages of the atmosphere; and elsewhere cause tremendous depressions of land, and sink in deeper hollows the original basins of the ocean.

The external influences, thus contrasted with the interior powers of the globe, are far more various in their aspect and more general in their visible operation; yet they may all be reduced to one or two variable forces, independent of the terraqueous system. It is to the unequal accession of heat from the sun, upon a globe whose distance varies, whose parts are variously presented to the radiating beams, and to the unequal abstraction of heat by the cold ethereal spaces in which the earth circulates, that we may refer all the variations of corpuscular and mechanical phenomena on the globe; while in the varying diffusion of light we recognise the prime element of change in the animal and vegetable world.

Minute as is their momentary impression, the sum of their effects in a long time is prodigiously great; heat and moisture by alternate influence weaken; frost bursts; carbonic acid eats with cankering tooth; rains, swallowed up by the fissured rocks, abstract parts of their substance; land-slips, avalanches, and glaciers heap the valleys with detritus, till swollen rivers or bursting lakes sweep away the burden towards lower ground, or convey it even to the sea. Thus chemically dissolved, mechanically suspended, or roughly rolled along, the substance of all the rocks and mountains yields to a slow but sure destruction, and those who, adopting the notion that 'time costs nature nothing,' take as much of this as pleases them, may easily see, in the effect of these operations, the total disintegration of the existing continents and islands, which is so conspicuous a feature in Dr. Hutton's hypothesis of the decaying and renewing earth.

Nor is the sea less a theatre of change than the land. For, independent of its receiving the spoils of the land, and distributing them on its bed, the untiring agitation of its waves undermines the cliffs which are above its level, grinds away the rocks which are covered and uncovered by the tides, and distributes the materials in various ways, here making dangerous sandbanks, there adding to the low shores a valuable heritage.

Nor even below the deep water of the middle ocean is all at rest. There multitudes of sea animals, the Infusorial Animalcules, the Zoophytes, and Mollusca, by their mere exuviæ tend to fill up the depths; and certain tribes (the lamelliferous corals in particular), by their peculiar growth and mutual adherence form calcareous islands and reefs, similar in some important particulars to the ancient limestone rocks. These coralligenous rocks are however not reared from the extreme depths of the sea, but based on the summits of submarine hills, or the crests of volcanic cones, and thus, in a general expression, we may say that in modern nature most of the deposits of solid matter in the sea are joined to the shores or shallows of the previously formed land.

The sediments transported by rivers, and gathered by the wasting of the elevated coasts, being for the most part deposited along the sea-shores, and almost wholly below the level of high water, it is obvious that from this cause alone the bed of the sea is filling up, and its depth diminishing toward the shores; but as the quantity of water on the globe must be supposed sensibly constant, it follows that the oceanic area must expand, or its surface rise a little. But since the land is wasted by the waves, as we may suppose the augmentation of area which results from this cause sufficient to balance the elevating tendency of the littoral deposits of sediment, and that upon the whole the effect of the watery agencies on the globe is insensible in altering the level of the surface of the sea, as compared to the deeper parts of its bed; it follows, as a strict consequence, that the area of the ocean is enlarging. This appears also probable from observation; for the small addition of marsh-land on particular shores, by the influence of rivers, winds, and storms, in raising littoral sediments above the reach of all but the extremely high tide, is not enough to balance the continual waste of land along many thousand miles of perishing cliffs. By the mechanical agency of water considered alone, the land is certainly losing in area continually. The accumulation of marine exuviæ on the bed of the sea acts in the same direction, and the growth of coral principally concurs in the same result. Left to watery agency alone then the land may be imagined to be continually diminishing, as Dr. Hutton and Sir Charles Lyell suppose. If the shores of the sea did not waste away, the annual additions of sediment brought from the uplands would everywhere cause the water to rise in level; if the land were supposed to overhang its base at a certain angle depending on the diameter of the earth, the area of the ocean would remain invariable; but as neither of these conditions applies, it is certain that the area of the ocean is extending, and probable that its level does not materially change.

Volcanic phenomena, the earthquake, and the ignivomous mountain, are to be viewed as cases of critical action. Whether the heat of the interior of the globe be the residual portion of its original temperature (chaleur d'origine of Arago), or generated by the access of water, or other bodies containing oxygen, to certain chemical substances, it is to the disturbance of its equilibrium that the violence and the tumult of volcanic excitement are owing. But there are other and more gradual effects of the distribution of heat in and upon the globe which require notice. The most important of these is the gradual change of level of certain parts of the land, as compared with the general level of the ocean, one instance of which is supposed to occur on the shores of the Baltic, where certain tracts appear to be slowly rising above the sea. (Lyell, in 'Philosophical Transactions,' 1835.)

Concerning this 'secular inequality' (as it may be termed), of level of land and sea, it is unfortunate that nothing at all important is known towards determining the important question whether the elevation of one tract of dry land or sea-bed is balanced or overbalanced by the depression of another. Lyell assumes that the depression of land from this cause exceeds the elevation, but it is difficult to find sufficient evidence for this important postulate; and to adopt it merely as a consequence of another unproved assumption of a continual compensation of the agencies of nature is altogether inadmissible.

If there be in the earth a pervading high temperature, which diminishes from the interior toward the surface, in consequence of the radiation from the surface, it appears from Sir John Herschel's reasoning (given in Mr. Babbage's 'Ninth Bridgewater Treatise') that along the shores of the sea the isothermal lines of the interior of the globe should rise, because of the continual deposition of imperfectly conducting sediments there. For thus the radiation of heat along these lines would be diminished until the interior heat had come nearer to the surface. By the consequent expansion of the subjacent earthy substances the sea-shore should rise, and thus the addition of sediment from watery action, and the effect of the effort to restore equilibrium in the disposition of the interior temperature would, upon the whole, coincide in minutely raising the surface of the sea.

It is chiefly near the sea-coast, on the land or in the ocean, that volcanic phenomena are at this day seen in activity, and this apparently because the admission of water to some depth below the surface is necessary to the excitement of the imprisoned forces of heat. The elevated cones and large areas of melted rock, or accumulations of scoriæ and ashes, mark one of the prevalent effects of the volcanic forces to be the withdrawal of matter from the interior to heap it on the surface of the earth. But the cavities left by this operation below the crust of the earth must often cause depression of masses of land during the concussion and displacements occasioned by earthquakes. In this manner it may easily be understood that the volcanic islands of the South Seas have been raised up from the sea-bed there, and it may be supposed that under large tracts of the ocean volcanic agency is employed in a similar way, and by a superiority of elevation over depression raising irregularly the bed of the sea, and by consequence extending the area of its surface. If all the cavities left below the surface by the heaping of volcanic matter on the land were completely balanced by corresponding depressions of the crust of the earth it would depend upon the proportion of submarine subsidence corresponding to terrestrial elevation whether the sea-level should fall and its area contract. Every sinking of the sea-bed corresponding to an elevation of the dry land would tend to lower the level of water and to augment the area of land. Along sea-coasts such correspondence must be admitted occasionally to occur. If the cavities alluded to were not compensated by the sinking of the superincumbent crust volcanic pheuomena on the land would hardly affect the area or level of the sea; but similar eruptions in the sea would raise its level and cause it to encroach upon the land. If it be admitted as the most probable basis of reasoning whether subterranean cavities exist or not, that the continual elevation is upon the whole balanced by continual subsidence, submarine and continental volcanic vents may be left out of consideration; but the littoral and insular volcanoes act in one certain way, and give as the general result of all volcanic action a partial deepening and a general contraction of the sea, which counterbalances in kind the general effect of the aqueous agencies; but whether these completely antagonist principles are equal in degree cannot be safely inferred from any data now accessible to geology. Nor does it appear prudent to rest so important a conclusion on the mere fact of the constancy of the earth's dimensions, indicated by the invariable length of the solar day; the experience of 2000 years is as nothing in a question of such infinitesimal differences of diameter as might be occasioned by changes in the relative position of the really small quantities of matter raised or sunk by volcanic powers.

Moreover it is impossible to avoid doubting whether even the quantity of water on the globe is constant; for so many combinations of earthy substances require certain proportions of water for their completion, and so much of volcanic excitement appears due to the decomposition of water, that it would perhaps be safer to suppose the water continually diminishing in quantity; nor is it at all unlikely that such may be the case with the atmosphere.

The question of the comparison of the effects of natural agencies in modern and ancient times is one of considerable importance in relation to geological enquiries.

The statement of the effects of modern causes must necessarily be received as true and applicable to other eras of the world, at least in its general features; because the chemical, mechanical, and vital forces of nature are admitted as individually constant, though their manifestations to our senses be ever so various in kind or degree, in consequence of change in their combinations, the quantities of matter operated on, external influences, &c. Fixed laws and variable conditions are certainly recognised in existing nature, and they give rise to extreme inequality in local results and combinations. It is conceivable, by extending this idea, that the existing laws of nature should be productive not only of results which, taken locally or periodically, appear unequal in degree or diverse in kind, but that under the influence of a general change of conditions they should manifest a gradual decay or increase of strength, or spring into extraordinary activity after long periods of apparent slumber. Let, for instance, the sun's rays be supposed to fall upon the earth in smaller quantity through the augmentation of the minor axis of the earth's elliptic orbit; let the temperature of the ethereal spaces rise: who does not see that all the effects depending on the external excitant forces would immediately change? In like manner let the earth's internal energy of heat be supposed to die away, whether for lack of fuel, incrustation over metalloids, or a loss of general warmth in the globe, the volcanic phenomena would be weakened, and no longer balance the effects of water.

Now, as these great conditions cannot be affirmed to be constant, but, on the contrary, as one at least of them is known to be variable (the earth's orbit), how "baseless as the fabric of a vision" is the assumption that the physical agencies on the globe have always produced "equal effects in equal times," and that modern causes acting with their present intensity have produced all the older phenomena of geology. But it would be equally unjust, as observed before, to assume that they have not; the question, if capable of determination, can only be settled by ample observation and logical induction.

Among the ancient phenomena of nature we equally recognise the contrasted action of water and heat, as at this day: by the former the solid land was wasted, and stratified rocks were deposited along the sea-shores (as sandstones) and in the depths of the sea (as some limestones), while the latter manifested itself in the production of unstratified crystalline rocks, and the elevation and disruption of the stratified bed of the sea. [ROCKS; STRATIFICATION.] The materials arranged by the action of water in the stratified rocks of ancient date are the same as those now carried by rains, suspended by the tide, or separated from sea-water by the vital functions of invertebrata; they are, to a certain extent, similarly associated: the organic exuviæ buried in them are not very differently arranged or grouped from those which now lie in the bed of the sea (Donati's 'Researches on the Bed of the Adriatic' may be quoted in proof of this); the physical conditions of their accumulation were therefore in a considerable degree similar.

On a careful consideration of the facts, it appears obvious that the long series of stratified deposits was not accumulated without great and even sudden changes of those physical conditions: thick deposits of sandstone are followed by others of clay or of limestone, for which different agencies and conditions were required. Over the same spherical area of the earth's surface the predominant physical conditions varied from time to time, and many times, so that the actual state of the globe, as far as regards watery agencies, represents not all its previous conditions, but is to be compared with each of them successively. The same is true of the igneous products in the crust of the globe, which similarly varied from time to time in the same spherical area.

Successive phases of the aqueous and igneous agencies over the same region appear, either contemporaneously or successively, to have affected all parts of the earth's surface accessible to man; so that everywhere there is proof of great revolutions in the condition of land and sea. Moreover it appears [ORGANIC REMAINS] that to each general system of stratified rocks, indicative of a corresponding great system of physical agencies, peculiar races of plants and animals belong:—with new physical conditions new forms of life came on the globe, vanished with those conditions, and gave place to others equally transitory. If now we compare the modern survey of nature with any similar work, executed on the same principle, for any one of the earlier epochs, it is certain that the earth has undergone many very extensive revolutions in all that respects its aqueous, igneous, and organic phenomena, before arriving at its present state: it is equally certain that between the epochs of these revolutions the state of the earth was not extremely dissimilar to that which we now behold; yet, because the organic beings preserved in the earth in each of these systems are peculiar to it, and differ from the others, and from those that now live, we cannot possibly doubt that the points of difference were numerous, general, and important.

To determine the cause of the change of physical conditions between one system of stratified rocks and another is not difficult. In existing nature such a change might be easily produced in almost every region by a disturbance of the level of some particular tracts of land, by one great movement or many successive displacements. For example, let the Isthmus of Suez or the Isthmus of Darien sink one hundred or a few hundred feet (perhaps scarcely beyond the range of the power of an earthquake), what mighty changes would be occasioned in the Indian, Mediterranean, Atlantic, and Pacific Oceans, over areas which would appear considerable even when compared with many ancient systems of strata—changes of stratified deposits and physical conditions, and consequent variations in the relative abundance and geographical distribution of organic beings. Now, though at this day no such mighty changes are witnessed, we have only to enlarge our conception of the actual effects of volcanic agency to see clearly that this is the power which was employed in producing them.

The analogy of the effects of aqueous and igneous agencies in all past periods of the earth's history being assumed, we may proceed to gather inferences as to the measure of the intensity with which they have operated, and the time which has elapsed during their operation. This requires at least a brief summary of the characteristic features of the phenomena of successive steps of the earth's formation, in the order of their occurrence. Observation can only guide us to a knowledge of the crust of the earth for a depth of a few miles at most; and from what we there behold it is probable that a much greater extension of the power of observing would really help us but little in tracing the history of the revolutions of our globe of which monuments remain for inspection. For at some moderate depth below the surface all marks of lamellar increase, indicative of periodical formation, cease; all monuments of life and watery action terminate; and we behold the effects of heat alone. The general basis of all the crust of the earth, in which we trace the combined results of igneous, aqueous, and vital energies, is a mass of crystallised rocks, the fruit of great and very general heat; which limits all inquiry in that direction.

From the surface of these interior crystalline rocks, mostly of the nature of granite, the monuments of physical changes left in the rocks are capable of interpretation by the application of the knowledge we have gathered of chemical, mechanical, and vital forces, but below it all appears at first sight dubious and dark. Were these rocks of igneous origin anterior to the whole crust of the earth now placed upon them? Or does the interior heat slowly reconvert to granite the masses of sedimentary strata laid upon it by external watery agencies? In the former case the monuments of nature are complete so far as any thing analogous to the present system of surface agencies is concerned; but according to the latter supposition, the earlier strata, with whatever of organic exuviæ lay in them, have been reabsorbed and melted into the hidden secrets of the earth, and a similar fate awaits their successors.

To assume the truth of either of these views is altogether contrary to the prudent spirit of modern philosophy: no inspection or analysis of the old granitic masses; no merely analogical comparison of them with the fluid compounds of existing volcanoes; no à priori reasoning will solve the question. Yet it appears capable of solution by a full and impartial consideration of the stratified crust of the earth itself, which ought to show in the nature and condition of the lower strata as compared with the upper, and in the nature and abundance and mode of conservation of organic remains, evidence not only of the circumstances under which they were accumulated, but indications of the nature and extent of the changes which have since occurred to them. This mode of inquiry we shall endeavour to follow.

This first diagram is intended to show how very small is the supposed depth of the crust of the earth, and of the most profound parts of the ocean, compared to the radius of the globe. The thickness of the crust of the earth, here taken at 15 miles, is perhaps on a general average not so much as 5 miles. To this mere film on the surface of the globe Inductive Geology is confined; though by help of collateral science we have learned many truths as to the constitution of the hidden interior masses.

The difference of the diameters of the earth is nearly 26 miles. If the axis of the globe were displaced 90 degrees, the level of the sea would rise at the old poles and sink at the new poles about half that quantity, or 13½ miles; and at other points intermediate quantities, according to their relations to the great circle passing through the new and old poles of rotation. At the poles of this great circle there would be no alteration of level.

By imagining the depth of 1000 miles, in the first diagram on the following page, to be repeated three times, and the three radii to be at the same time prolonged till they meet at a point, which would represent the centre of the earth, the reader will easily form a notion of what is intended.

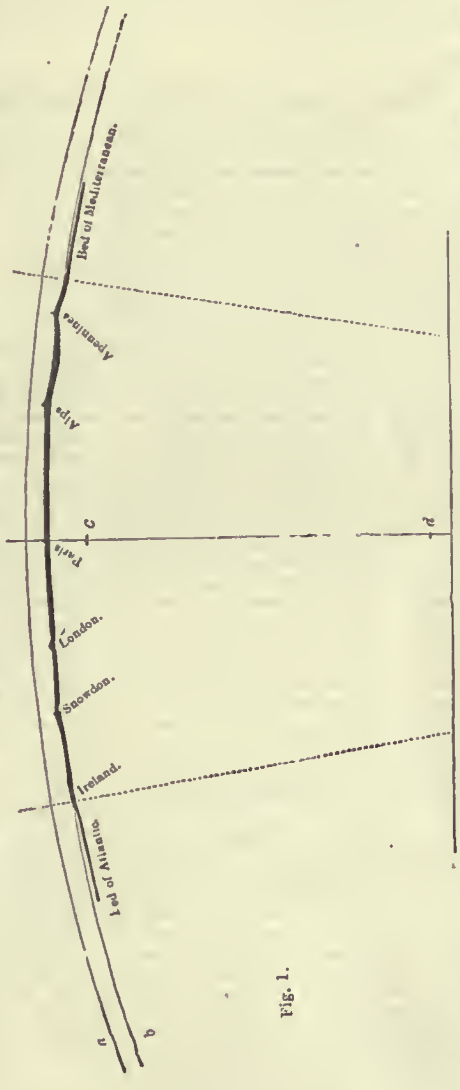


Fig. 1.

a, line representing the supposed limits of the atmosphere, 45 miles above the earth; *b*, level of the sea; *c*, depth of 100 miles on the radius, the black part being the supposed thickness of the earth's crust; *d*, depth of 1000 miles.

The arc includes 20 degrees from the Adriatic to the Atlantic, passing over the Apennines, the Alps, the English Channel, the Welsh Mountains, and the Irish Sea, the depth of the narrow seas being less than the breadth of the fine lines.

Fig. 2.—A general section of the crust of the globe, about 100 miles in length and one mile in depth, from Bridlington, B, to Whitehaven, W, on a true scale, that is, the height proportioned to the distances. G, the granite, appearing under the slaty primary rocks, P, of Cumberland, which rise to the height of 3160 feet; C, the carboniferous system, rising to the height of 2901 feet in Crossfell; R, the red-sandstone, or saliferous system, usually found in very low ground; O, the oolitic system, rising to 1485 feet in the Hambleton hills; Cr, the cretaceous system, which, at its highest point in the York Wolds, is 805 feet above the sea; *d*, dykes of basaltic or porphyritic rock; *f*, a great dislocation.

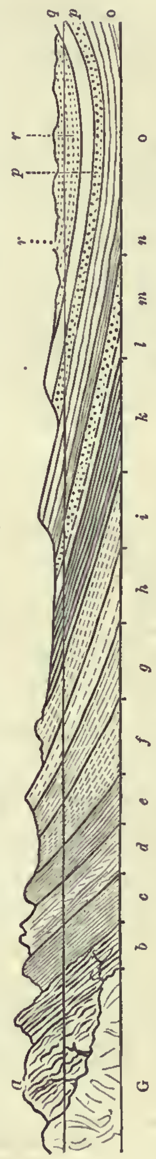


Fig. 3.—General view of the succession of British strata, with the elevations they reach above the level of the sea.

G, granitic rocks; *a*, gneiss; *b*, mica schist; *c*, Skiddaw or Cumbrian slates; *d*, Snowdon rocks; *e*, Plynlymmon rocks; *f*, Silurian rocks; *g*, old red-sandstone; *h*, carboniferous limestone; *i*, millstone grit; *k*, coal-measures; *l*, magnesian limestone; *m*, new red-sandstone; *n*, lias; *o*, lower, middle, and upper oolite; *p*, greensand; *q*, chalk; *r*, the tertiary strata.

The general section (*fig.* 3), combined with the complete table of British strata which follows (extracted from Phillips's 'Guide to Geology') will serve for reference to the reader who may be unacquainted with the arrangement of the stratified rocks in the crust of the earth.

Series of British Strata, beginning at the Surface, from which all Water-Moved Gravel and River Sediments are supposed to be removed.

The Marine Strata are marked by Figures; the Fresh-Water and Æstuary Beds by Letters; the names of some characteristic Fossils are in Italics.

TERTIARY STRATA.

(A small number of the Fossils are identical with existing species.)

Names of Formations.	General Thickness. Yards.	Remarks.
1. Clay	16	A water-drifted mass of marine shells, pebbles, &c., resting on more regular shelly beds of sand or sandy limestone. About 40 per cent. of the shells are supposed to be identical with existing species.
a. Fresh-Water Marls	33	They include a bed of æstuary shells, and occur only in the Isle of Wight.
2. London Clay	100 to 200	Mass of clay rich in marine shells, of which $3\frac{1}{2}$ per cent. are identical with recent kinds.
2. Plastic Clay	100 to 400	Variously coloured sands and clays, the latter containing organic remains identical with, or much allied to, those of the London clay.

SECONDARY STRATA.

(All the Fossils belong to extinct species. They are different from those in the Tertiary Strata.)

System.	Names of Formations.	General Thickness. Yards.	Remarks.
Cretaceous System.	3. Chalk	200	Of unequal hardness, soft above, marly below, with interstratified flints; extinct *Zoophyta*, *Ananchytes*, and other *Echinodermata*.
Cretaceous System.	4. Greensand	160	Upper Greensand, very fossiliferous, in general chalky. Gault, a blue marl, or clay, often very fossiliferous. *Belemnites minima*. Lower greensand, or iron-sand, very fossiliferous in places.
Oolitic System.	b. Wealden	300	Weald clay, with fresh-water shells. *Cyprides*. Hastings sands, with land-plants, and bones of *Iguanodon*. Purbeck beds of clay and limestone, with fresh-water shells.
Oolitic System.	5. Portland Oolite	130	A variably locally oolitic limestone; some beds full of fossils. Kimmeridge clay, with layers of *Ostrea deltoidea*.
Oolitic System.	6. Oxford Oolite	150	Upper calcareous grit. Coralline oolite, with beds and masses of coral; *Echinida*; many shells. Lower calcareous grit. *Ammonites catena*, *Pinna lanceolata*. Oxford clay. Kellaway rock. } *Ammonites Calloviensis*, *Gryphæa dilatata*.
Oolitic System.	7. Bath Oolite (near Bath)	130	Cornbrash, thin, impure, shelly limestone. *Avicula echinata*. Forest marble. Shelly oolite, with concretionary sandy limestone. Bath oolite. In several divisions, shelly, oolitic, compact, and sandy beds. *Megalosaurus*, *Apiocrinus*. Fullers'-earth. A series of calcareous and argillaceous shelly beds. Inferior oolite. *Pholadomya*. *Trigonia striata*. Sand, with concretionary masses holding shells.
Oolitic System.	8. Lias	350	Upper lias shale. Full of characteristic saurians, of *Ammonites*, *Belemnites*, and other shells. Marlstone, replete with *Terebratula*, *Pectinida*, *Avicula inæquivalvis*. Middle lias shale. Contains *Gryphæa*, *Ammonites*. Lias limestone, with *Gryphæa incurva*, *Ammonites Conybeari*. Lower lias shale and coloured marls.
Saliferous, or New Red-Sandstone System.	9. New Red-Sandstone	300	Coloured marls, gypsum, and rock salt. Red and white sandstones and marls. Conglomerate and sandstone. } Few or no organic remains.
Saliferous, or New Red-Sandstone System.	10. Magnesian Limestone	100	Knottingley limestone. A few bivalves in the lower beds. Gypseous red marls. No fossils. Magnesian limestone. Shells, corals. Marl slate. Fishes of remarkable forms. Red-sandstone. Plants of the subjacent coal series occur in it.
Carboniferous System.	c. Coal	1000	The subdivisions of the coal series are only locally ascertained. Gritstone and shales constitute the principal mass. Flagstone and iron-stone are among the most characteristic layers. Fresh-water limestone and marine limestone are exceedingly rare and local. The shells are mostly of æstuary origin. The plants are mostly of terrestrial tribes and extinct genera.
Carboniferous System.	11. Carboniferous or Mountain-Limestone	800	Millstone grit, series of sandstone, shales, coal, and thin limestones, forming a transition group between the coal and the carboniferous limestones. Yoredale rocks, consisting of five or more beds of limestone, with alternating flagstones and other gritstones, shales, thin coal, iron-stone. Lower or scar limestone, in the north of England and Scotland, subdivided by sandstones, shales, and coal seams. They yield characteristic *Crinoidea*, *Productæ*, *Spiriferæ*, *Orthocerata*, *Bellerophon*, *Goniatites*. Alternating limestones and red-sandstones, forming a transition group between the carboniferous limestone and red-sandstone formations.
Carboniferous System.	12. Old Red-Sandstone	100 to 3300	Conglomerates and sandstones. No fossils yet noticed. Coloured marls and concretionary limestones, called 'cornstones.' A few fossils. Tilestones, or flagstone beds. A few fishes.

PRIMARY STRATA.

All the fossils belong to extinct species, and often to extinct genera and families. They are different from those in the Secondary and Tertiary Strata. It has been usual to class the upper systems under the title of Transition Strata, and to confine the name of Primary to the mica-schist and gneiss systems. The following view of the Silurian Strata results from Sir Roderick Murchison's researches:—

System.	Names of Formations.	General Thickness. Yards.	Remarks.
Silurian, Upper Grauwacke, or Transition System.	13. Ludlow Rocks	660	Sandstones. Species of *Orbicula*, *Lingula*, Terebratula, Spirifera. Limestone. *Pentamerus*, *Homonolotus*. Shale.
Silurian, Upper Grauwacke, or Transition System.	14. Wenlock Limestone	600	Limestone. Shale. } Corals and Crinoidea in vast abundance. *Euomphali*, *Producta depressa*, Orthocerata, *Calymene Blumenbachii*, and other Trilobites.
Silurian, Upper Grauwacke, or Transition System.	15. Caradoc Sandstone	830	Shelly limestone. Various sandstones. } *Pentamerus*, Terebratula, *Orthis*, Trilobites.
Silurian, Upper Grauwacke, or Transition System.	16. Landeilo Rocks	400	Calcareous flaggy beds, including *Asaphus Buchii*, and other Trilobites.

The stratified argillaceous rocks below, from the rarity of organic remains and other causes, are not so perfectly understood. The following arrangement, based on the labours of Sedgwick, is however correct, with reference to the succession of deposits in the Welsh and Cumbrian districts. The thicknesses are not exactly known.

Cambrian System.	17. Plynlymmon Rocks	Argillaceous indurated slate, sandy slates. No fossils yet found in it. Calcareous and argillaceous rocks, with *Orbicula*, *Zoophyta*, and other organic remains.
	18. Bala Limestone	Calcareous and argillaceous rocks, with *Orbicula*, *Zoophyta*, and other organic remains.
	19. Snowdon Rocks	Variously coloured and indurated argillaceous slate. A few fossils have been observed in Wales.
Skiddaw System.	Clay Slate	Soft dark slate. No fossils known.
	Chiastolite Slate	Soft dark slate, with chiastolite. No fossils known.
	Hornblende Slate	Soft dark slate, with hornblende. No fossils known.
	Mica-Schist System	No organic remains. The beds of mica-schist, composed of mica and quartz, alternate with gneiss, chlorite-schist, talc-schist, hornblende-schist, clay-slate, quartz-rock, and primary limestone.
	Gneiss System	No organic remains. The gneiss beds, composed of mica, quartz, and felspar, alternate locally with mica-schist, quartz-rock, and primary limestone.

Primary Periods.—Gneiss and mica-schist, two of the most abundant of the oldest stratified rocks, appear, as to their substance, to be composed of the same parts as granitic rocks, namely, felspar, quartz, and mica, with great variations of proportions, and some admixtures and substitutions of other minerals, constituting alike granite, gneiss, mica-schist, &c. But the ingredients are not in the same condition;—in the granite all are crystallised; each mineral is independently a crystal, or moulded in the cavities left between crystals; in gneiss and mica-schist the felspar, quartz, and mica are rolled or fragmented masses. The character of worn surface of the ingredients, combined with the lamination or stratification of the mass, assures us that aqueous agencies have determined the aggregation of gneiss and mica-schist: the character of the lamination, especially the minute flexures which abound in these ancient rocks, suggests somewhat of peculiarity in the condition of the water; and the internal crystallisation of the attrited felspar reveals its origin from the disintegration of granite.

On the other hand it has been contended that the similitude of the mineral composition of gneiss, or mica-schist, to granitic compounds argues a similitude of origin; and by some writers gneiss, mica schist, &c., are regarded even as igneous rocks; by others it is thought that gneiss and mica-schist are intermediate products between sandstone and granite, retaining the lamination and bedding which indicate their original aqueous origin, but assuming a new mineral composition in consequence of the agency of heat. Neither of these views appears satisfactory; to give a merely igneous origin to gneiss is evidently to leave out half the phenomena; to suppose the mineral composition of gneiss the effect of heat operating on a common sandstone will never be allowed by those who have studied the rock as it appears in Zetland, Scotland, or Norway; for in all these places it is clear that the granular minerals have not derived their external figure from concretionary but really from mechanical action, while their exterior structure is truly crystalline. There is however one mineral frequently found crystallised in gneiss and mica-schist, namely, garnet; and the history of this mineral leaves no doubt that the rocks in which it lies have been pervaded by a general high temperature, enough to affect such a fusible substance as garnet, but not enough to melt any one of the regular constituents of granite. Here then appears decisive testimony as to the degree of heat which the gneiss and mica-schist have experienced. By the operation of this pervading heat the particles of calcareous rocks associated with gneiss and mica-schist have undergone a great change: they have been converted to crystallised marble of various colours and qualities.

The arguments above advanced, conclusive as we deem them on the subject of the origin of gneiss generally, are not intended to apply to cases where, by reason of this rock being buried at great depths below the surface, extraordinary effects of heat may be experienced. There, no doubt, the gneiss such as we see it, clearly revealing the history of its formation, may be wholly melted and re-crystallised, so as to lose entirely all traces of its origin. Some such cases may occur, perhaps even we may admit that evidence for them exists in uplifted granitic regions; and thus some of the monuments of the earth's early history may have been lost: but that this cannot be the general rule almost every mountain-chain bears testimony.

In these, the most ancient rocks which exhibit to us the combined effects of aqueous and igneous agency, no traces of animal or vegetable life occur, and the conclusion we adopt on the subject is, that few or none of the organised wonders of nature were then in existence, because the physical conditions of the globe within which the existence of animals and plants is limited were not then established. Only one other view of the subject is worthy of notice. According to the hypothesis of the slow reconversion of stratified rocks to granitic compounds, the want of traces of organic forms in the gneiss and mica-schist is ascribed to the destroying agency of heat on the calcareous matter of shells, corals, &c., and the carbonaceous substance of plants. That heat will affect such calcareous and carbonaceous compounds in the manner assumed is certain. Perhaps it might be difficult entirely to reject the hypothesis in the case of the primary limestones, whose alteration to crystallised masses may be thought to have wholly destroyed the structure of the shells. Yet as in the limestone of Teesdale, similarly altered by contact with trap rocks, crinoidal stems retain their forms; and as near granite, trap, &c., vegetable remains are recognised, if not in substance, yet at least by their impressions in the shales or grits; and as, finally, among some rocks of the same mineral nature as gneiss and mica-schist, shells and plants of many sorts appear in the Col du Chardonnet in Dauphiné, the balance of evidence is decidedly against this extreme application of the theory of metamorphism of rocks.

Upon the whole then the evidence afforded by a careful examination of the oldest strata, in regard to their mineral composition, structure, and absence of organic remains, supports, we will not say establishes, the opinion that these are not only the most ancient strata which man can trace, but the oldest products of watery action on the globe, and in a great degree anterior to the origin of organic life.

The general results to which the study of the earliest systems of strata lead are these:—

1. They are the oldest aqueous deposits visible on the crust of the globe, and rest on masses which have received their present aspect from the action of heat.

2. They furnish no proof of the contemporaneous or previous existence of dry land.

3. They are equally destitute of evidence of the contemporaneous or previous existence of plants or animals in the sea.

4. The rocks of this ancient system are peculiar in their aspect, and though doubtless derived from disintegrated granite, &c., the constituent particles appear to have undergone much less attrition than those which compose rocks of later date.

5. These rocks are of such great extent as to approach nearer to universal formations than any of later date.

As a general inference, it appears that the circumstances which accompanied the accumulation of these rocks were greatly different from what we now behold, since nowhere on the sea-shores are any such products found, nor can we suppose anything analogous producible in the bed of the sea, unless where some peculiar agitation of water may hasten the disintegration of granite. The impression was very strong among early writers of the entire want of accordance between the causes of those early strata and those now in action. De Luc ('Lettre' iii.) more reservedly says, "We have no reason to expect that the operations of those times can be explained by specific analogies with what we observe in the present state of the earth."

And as one general hypothesis, we may say with the followers of Leibnitz and Fourier, that the proper internal heat of the earth was then only just so much reduced as to allow of a peculiar watery action upon its cooling crystallised masses, but not enough diminished to allow of the conditions within which the existence of organic beings is restricted on the earth.

This hypothesis is independent of the consideration already presented as to the original condensation of the globe, and cannot, we believe, be objected to on the ground of anything known concerning the present state of the interior of the globe; on the contrary, the temperature of the earth augments as we proceed downwards, and this fact, being general, has been shown by Fourier to be inexplicable except as a consequence of a general high temperature now existing in the earth. The planetary spaces round the earth are colder than any part of its surface (Fourier), and continually abstract heat from it: the globe is continually growing colder though at an insensible rate, and must have formerly been hotter, and then must have lost heat more rapidly. The obvious conclusion from the mathematical theory of the heat of the globe, coupled with observations of the temperature below the surface, leads to the adoption, as an inference from facts, of the view above proposed as an hypothesis to explain other facts. [Gneiss; Mica.]

Skiddaw, Cambrian, and Silurian Systems.—These argillaceous rocks of the primary series of strata bear the same relation to the gneiss and mica-schist as common clays bear to common sands in modern nature. Some clays are not really more distinct from particular sands in their mineral nature than in the comparative fineness of their constituent particles. In consequence of differences of magnitude and density, particles of clays and sands which are derived by watery action from the same sea-cliff, avalanche, or glacier, are soon separated, carried to unequal distances, and deposited in distant masses. Such, in many cases, is the true origin of the sandstones and shales of the secondary strata, and processes somewhat analogous may perhaps be supposed to have occasioned the remarkable distinctness and even reciprocity of occurrence of the gneiss and mica-schist on the one hand, and the slaty rocks on the other. It is seldom that both of these types of primary strata abound in the same geographical region, though there is little doubt that both are derived from a granitic basis. In some cases we may best conclude that the materials of the slaty rocks were obtained from the wasted gneiss and mica-schist.

Enormously thick as these argillaceous masses are, and extensive as is their geographical distribution, they offer in all countries a general character of aspect which easily arrests the attention and impresses the memory. The colour usually approaches to blue, gray, green, or purple; the texture is usually fine-grained, but portions are included not very different from sandstone or conglomerate (grauwacke, or clasmoschist of Conybeare); the structure is laminated and bedded more or less perfectly, and often in addition complicated with regular symmetrical joints; there is another entirely distinct set of such divisional planes called 'cleavage,' traversing the planes of deposition. All these circumstances give to the primary argillaceous rocks a determinate aspect. The limited limestones which interlaminate the mass are seldom so crystalline as those in gneiss and mica-schist, and they, as well as the upper and some other parts of the slaty rocks, generally yield organic remains, occasionally in great abundance. These are almost wholly marine (local deposits of land-plants occur), and the animals belong to invertebrate tribes—*Zoophyta*, *Conchifera*, *Crustacea*—and augment in number and variety as we pass from the lower to the upper parts of this series of rocks. [ORGANIC REMAINS.]

From a contemplation of the slaty rocks it results:—

1. They not unfrequently rest on the granitic rocks with scarcely any interposition of gneiss or mica-schist (Cornwall, Cumberland, &c.)

2. The proofs which they offer of the existence of dry land are chiefly (or wholly) derived from the organic remains of plants, which are not certainly known among the lower groups, but become tolerably plentiful in the upper parts of the systems.

3. The marine organic remains, shells, corals, *Crustacea*, &c., are very scanty in the older systems, and grow more and more numerous and varied towards the upper strata.

4. The forms and structure of these earliest known fossil races of animals have no extraordinary degree of simplicity, nor are they confined to the lowest or least complicated tribes of *Invertebrata*.

5. The alterations which the rocks have undergone by the action of heat are general, sufficient in most countries to superinduce new structures (slaty cleavage), but not to destroy the traces of organic remains.

A greater resemblance appears among these fine-grained strata to the deposits from modern waters than is found in the earlier rocks: there is less of peculiarity in their laminar and stratified structure; they are more varied; and the alternations of deposits indicate greater variety of natural processes and new conditions, such as the elevation of land, the wasting effects of the atmosphere, and littoral agitation, might occasion.

We may suppose, in order to account for the origin and gradual augmentation of the traces of organic life, that the flow of heat from within the globe to the surface was retarded by the effect of previous cooling, and by the addition of the older sedimentary rocks above the granite; and this is in harmony with the fact that generally the limestones of this system are less crystallised than those which are of older date. [CAMBRIAN ROCKS; CUMBRIAN ROCKS; SILURIAN SYSTEM.]

Passage from the Primary to the Secondary Period of Geological Time.—Before the close of the Primary period we find that some limited tracts of land were reared above the waters, so as to nourish the plants which occur in the grauwacke slates of North Devon and the banks of the Rhine (supposing, with the general opinion, that the fossiliferous rocks of Baden, &c., are of this age). The sea had become entirely fit for the residence of marine *Zoophyta*, which abounded so as to constitute reefs and islands; *Conchifera* and *Gasteropoda* forming extensive beds; *Trilobites* of many kinds, and a few traces of fishes. These however are chiefly in the uppermost of the primary series, and would be ranked as transition deposits by all geologists who use that now neglected and somewhat hypothetical term. Yet it is impossible not to be struck by the gradation of character which connects into one long series the granitoid gneiss and the arenaceous Ludlow rocks; the fine-grained gneiss and mica-schist with the fissile Snowdon slates and argillaceous Wenlock shale. In proportion as the deposits on a great scale resemble in character of accumulation those of modern times, so the organic remains appear more and more abundant. Some general change of physical condition, such as perhaps only a change of heat will explain, must evidently be admitted as an hypothesis to connect together this series of phenomena.

After the deposition of the primary strata, the interior forces of heat, no longer operating by a gradual metamorphosis of the previously deposited strata, and by a regulated change of the condition of the sea, appear to have been thrown into a state of critical action, and to have operated on the aqueous deposits of ancient date, as at this day the volcanic fires below affect the sedimentary strata accumulated from water above. There is hardly a mountain-range of much importance throughout the world where the effects of great convulsive movements affecting the primary strata cannot be seen: frequently it is ascertained to be the case that these movements happened before the production of any of the secondary rocks; and upon the whole it is evident that the crust of the globe was broken up and disturbed, and the relative geographical distribution of sea and land materially changed by the disturbance. The effects immediately appear: the introduction of a new order of sedimentary deposits, with new geographical relations; the extinction of old and the creation of new groups of organic beings; the commencement of a new act (so to speak) in the great history of the earth.

What relation do the great convulsions here alluded to bear to the movements of a modern earthquake? They are unquestionably due to the same general force, namely, internal heat: a disturbance of the equilibrium of this force is in each case to be admitted—the causes and effects are analogous—but is the modern earthquake due to a physical agency of equal intensity with that which occasioned the ancient convulsions of the earth's crust? The uplifting of a mighty range of mountains is a common event, a characteristic occurrence of early geological periods: minute and partial changes of level accompany some modern earthquakes. There is no possibility of explaining the former by the latter, except by taking them as differential quantities, proportioned to the time elapsed, assuming that they always (or on an average) operated in a certain direction; and thus summing an almost infinite series of minute changes to make one decided revolution. This is, and must necessarily be, the view of the advocates of the invariable constancy of the measure of natural agencies.

It is enough, in reply to this speculation, to point to the phenomena which require explanation: they are too mighty in extent, and have too much simplicity and even rarity of character to allow of the faintest belief that this hypothesis can be true. On a minuter inspection this conviction is deepened by the want of any proof of the occurrence of these thousands of small movements, which must have succeeded one another for the production of the given effect. On the contrary, the enormous and simple displacements, 100 to 4000 feet in a vertical line, and ranging 10 or 100 miles in length; the mutual connection of such faults; the laws of their relative direction, and other phenomena, utterly reject such an imaginary representation of the measure of primeval igneous agency. A much less improbable view, that the whole movement of a great mountain-chain was accomplished by gradual elevation or depression, operating through long time in one direction, is apparently difficult to reconcile with the narrow and steep ridges produced, the numerous and powerful flexures of thick rocks, the sudden and great fractures, and other characteristic phenomena.

We are therefore driven to believe that the igneous effects of earlier date were far more powerfully and generally excited, at particular epochs, than is now observed to be the case. We may be satisfied that the present aspect of the earth is to be viewed as a period of comparative repose; a period of ordinary and regular action, and frequent compensation among the agencies of nature; and may satisfactorily compare it with the whole or some part of the primary period, but not use it as a measure of the violence which accompanied the transition from one early period to another, and thus, amidst great local or general disorder, restored the equilibrium of the interior and exterior agencies of natural changes. This being supposed, the volcanic excitements of modern date being taken as the terms of a series of effects of partial and local disturbances, and re-establishments of equilibrium, there may yet remain residuary phenomena not so compensated, till some critical combination of events opens a wide access to the interior energies of heat. It is even probable that such do remain. The cavities left by the ejection of lava under the Andes are probably not all compensated by the sinking of the earth in the vicinity, because of the resistance of the coherent crust of rocks above; yet such resistance is limited, and it is at least conceivable that some part of that mighty range may fall in, as did a great portion of Papaudayang in Java (1772).

What is here concluded to be true at this day for volcanic regions taken singly, may easily be assumed to be probable for large portions of the earth, when the igneous energy was capable of more general results, because not determined to many local centres of continual or intermitting effect. But we must not leave out of consideration the gradually diminishing force of heat in the globe, whether this be due to a gradual lowering of its proper temperature, or a gradual stifling of calorific chemical processes. The loss of that heat by mere radiation into the cold planetary spaces is a residual phenomenon of infinitesimal value indeed, but of general application to the whole globe, and capable in long time, and independently of local volcanic action, of amounting to a tremendous force. For the heat of the surface of the earth being determined by the heat of the sun and the cold of its planetary path, the exterior crust would contract less than the interior nucleus, and it would depend on various considerations whether at all, and after what intervals, a violent crushing of the crust should happen to relieve the extension of the solid or fluid nucleus. During the earlier periods of refrigeration such critical disruptions may have heen frequent; at later times they would occur after long intervals, with greater violence; and finally, when solidification had gone to a certain depth, there might be no subsequent paroxysm, so long as no external agency came to aid the interior tension.

It may perhaps be worth remarking that the atmosphere of the earlier eras of the world known to geology must be supposed to have transmitted light, much as happens at present, else we should not find the eyes of fossil trilohites constructed as are those of analogous *Crustacea* at this day. (Buckland, 'Bridgewater Treatise.')

Secondary Periods of Geology.—On the undulated hed of the sea, round the ranges of primary rocks raised in insulated tracts by great convulsion, secondary strata were formed, sometimes evidently derived from the waste of the primary strata, through the influence of atmospheric agency, or the wearing of the sea on its shores. But a considerable portion of these strata is of purely marine origin; the calcareous strata may be considered as derived from chemical decomposition of the sea-water, separated from it by the vital functions of *Mollusca* and *Zoophyta*, or generated hy springs rising in the sea and loaded with carbonate of lime. Of all these modes of formation modern nature offers illustrations, some of them so extensive as to admit of comparison with many of the ancient limestone rocks. Others of the secondary rocks appear to have heen formed of ejected volcanic matter, ashes and scoriæ, which by diffusion in water have settled into deposits of considerable extent. The total thickness of the secondary rocks is but small when compared with that of the primary groups, nor are they, it is probable, spread over such exteusive areas; hut in the variety and number of alternations of the different sorts of rocks and in the diversity of their imbedded organic fossils they are altogether superior. There is among them far more of the differences which separate oceanic from littoral deposits; and we see ahundant proof that during their aggregation the arrangements of nature were extremely analogous in general features to what we now see, however great and numerous the points of difference may be.

On an attentive consideration of the several systems into which the secondary strata are grouped, namely (in the order of superposition),—

Cretaceous System;
Oolitic System;
Saliferous, or New Red-Sandstone System; and
Carboniferous System,

it will be perceived that to each of them belong littoral, marine, and oceanic deposits; sandstones having heen chiefly collected amid the agitation of the shores, clays accumulated in quiet hays or gulfs, and limestones aggregated in deeper water; and in each system, each of these classes of deposited rocks contains somewhat characteristic, if not entirely peculiar: sandstones, more or less felspathic, dark hituminous shales, and gray limestones occur in the carhoniferous system —red or blue colours belong to the sandstones and clays, and magnesiau combinations to the limestones of the next incumbent rocks; light-coloured sands and pale-hlue clays, with yellowish limestones, mark the oolitic system; and green or ferruginous sands, marly clays, and soft white limestones distinguish the cretaceous rocks.

These distinctions are important, as guiding us to a right general view of the changes of physical conditions which occasioued them. These it is prohable related chiefly to hydrography, and when we have geological maps complete enough to make the required comparisons as to the extent and distrihution of the rocks, it appears possihle that the direction of oceanic currents, the lines of ancient houndary of land and sea, may become sufficiently known to determine the particular suhterranean movements which introduced new conditions aud produced new deposits in a given basin of the secondary ocean.

Each of the great systems alluded to is characterised hy the plants and animal remains which lie in it: the *Lepidodendra* of the carhoniferous sandstones and shales yield place to the *Voltziæ* of the red-sandstone, and the *Cycadaceæ* of the oolites; the *Productæ* of the carboniferous limestone are never seen among the oolites, which abound with *Trigoniæ*, *Pholadomyæ*, &c., nor in the chalk, from which these forms are absent; ammonites belong to all the systems, but the groups differ in each; belemnites are confined to the two upper; hamites, scaphites, &c., are scarcely met with out of the cretaceous rocks.

These statements might be enormously multiplied [ORGANIC REMAINS], but enough is said to show that the great features of lithological distinction are accompanied hy striking characters of organic remains. These characters, so far as marine life is concerned, may evidently be understood by the same inference of a change of oceanic currents; but the differences of the vegetable world seem to bespeak a general change of the characters of climate.

Reviewing the four systems in succession, we shall find circumstances in each strongly indicative of peculiar combinations of the physical agencies of nature.

Carboniferous System.—To what shall we ascribe the abundance of vegetation which furnished the materials of our coal strata?—an ahundance so great as, upon any hypothesis of accumulation on the spot where the plants died, or in the sea to which currents drifted them, appears to have no parallel, unless amongst the most umbrageous forests of Tropical America. By the gradual decay and periodical transport of the woods on the Mississippi or Orinoco we may perhaps best understand the accumulation of many heds of coal, alternating with a far greater numher of much thicker earthy sediments; hut even these aboriginal forests seem unequal to produce such enormous coal deposits as we find in Britain and other parts of the northern zones of the globe. The circumstances, whatever they were, which favoured this development of vegetable power, were never repeated, at least in these zones, though deposits of a similar nature to the series of coal strata, and likewise containing fossil plants aud thin beds of coal, diversify the sand and sandstones of the oolitic, cretaceous, and tertiary eras.

As a general inference we may observe that all the great thickness (2000 or more yards) of the carhoniferous system (excepting perhaps part of the old red-sandstone series) is clearly derived from wasted lands or sea-coasts, or from a decompositiou of the sea-water by vital or chemical agency. [COAL; COAL FORMATION.]

Whatever was the length of time which elapsed during the accumulation of the carhoniferous strata, it appears to have passed with little disturbance of the level of land and sea; for not a single example (we believe) is mentioned of any real unconformity of stratification in the whole series, from the base of the old red-sandstone to the uppermost line of the coal strata. The ordinary agencies of the atmosphere and the waves were in full employ, and some traces of volcanic eruptions appear in the trap of Derbyshire aud the north of England; hut there is not in the accumulation of the often repeated alternations of limestone, sandstone, shale, &c., of the carboniferous system, anything to require the supposition of greater general convulsions. It was a period not of repose, but of regular and orderly action among the agencies of nature, so far as the parts where now Europe and North America are situated: and the mineral deposits and organic remains are to he compared with existing operations of nature, in order to learn the physical coudition of the ancient land and sea.

After the formatiou of the carboniferous strata was ended in Europe and America, the long tranquillity of the ocean in these parts was broken by extensive and violent concussion, so that hardly a single square mile of country can anywhere be found which is not full of fractured and contorted strata, in consequence of subterranean movements which mostly preceded the accumulation of the next system of strata.

The relations of land and sea were so greatly changed hy these transient convulsions, that the new ridges of land and islands appear to have been variously scattered in the ocean which flowed round the already uplifted Grampian, Scandinavian, and Welsh mountains. An equal or greater extent of laud appears to have heen elevated in Ireland, but with less violence and concussion; and it is remarkable that some of the greatest faults produced at this epoch were almost wholly unaccompanied hy the irruption of any igueous rocks, or any other signs of merely volcanic action (Craven fault, great dyke of Tynedale, South Wales coal-field, &c.)

The Red-Sandstone System, which is deposited upou aud arouud the broken tracts of the carhoniferous system, presents us in some respects with new conclusions, which however seem almost equally to apply to the old red formatiou. No douht the sands and clays of this system were collected from wasted land aud sea-coasts, and deposited in shallow waters. But whence came the red aud greenish colours so characteristic of these strata and the analogous old red formation? The grains of sand which compose much of the rocks are not red, hut white rolled quartz sand, surrounded hy red peroxide of iron like a varnish. From none of the older rocks could this ahundant red pigment be derived so as to stain the whole sea-hed for 1000 feet or yards in depth. It has been thought that volcanic action alone can explain the occurrence of this iron. It is not however improhahle that the oceans which deposited the red-sandstone may have held protoxide of iron dissolved in carhonic acid; aud that from this solution the peroxide of iron was precipitated, as is seen in iron-springs at the present day.

Instead of the great quantity of vegetable matter huried in the coal tracts, we have in the principal part of the red-sandstones hardly a few insignificant traces—so few in England that scattered fragments are valued in geological reasoning; neither are the marine reliquiæ of the magnesian limestones in the midst of the red rocks at all plentiful, except in a few spots. Even taking the richer German series as a type, the red-sandstone rocks must he pronounced singularly deficient in organic fossils; and as, generally speaking, the same deficiency of organic life helongs to the older red-sandstone below the mountain limestone, it is at least a plausihle suppositiou that the causes of the red colour and paucity of animal life are somehow closely connected. If we imagine that by reason of the great convulsions which followed the carboniferous era new currents were hrought into the same areas of the ocean from tracts yielding ahundance of new sediments, the extinction of organic life would he the natural consequence, to he followed afterwards by a gradual revival—which is nearly the truth. In the magnesian limestones of this system expire many of the forms of the older carboniferous period, and at higher levels (as in the Muschelkalk) we find a strong resemhlance of the marine *Zoophyta* shells and *Crustacea* to those of the younger oolitic system. Upon the whole there seems reason to think the new red-sandstone system could not have occupied a long time in its formation compared to other deposits of equal thickness. [RED-SANDSTONE FORMATION.]

Oolitic System.—Into the same European and Asiatic basins which received the red clays, red sands, and magnesian limestones of the last system, subsequent agencies brought blue clays, sands more or less ochraceous, and limestones characterised by an oolitic texture. These deposits are parallel to the old rocks below, and no trace of any change of level in the region where they occur has been noticed in England—perhaps not in Germany. Must we refer to some distant convulsion for an explanation of the change of sediments, and for the equally great change, or rather sudden development, of organic life, which comes in with the oolitic era? New and more abundant forms of plants (*Cycadeæ*), with many varieties of *Zoophyta*, *Mollusca*, *Crustacea*, fishes, and gigantic reptiles of the land, rivers, and the sea, mark the oolitic rocks, and render them justly comparable, as a system, to the great carboniferous assemblage of strata. Locally indeed the oolitic rocks yield coal among the interpolated grits and shales, just as happens among the rocks interstratified with the older mountain limestone.

The resemblance of the oolitic to the carboniferous limestone tracts is extremely great in general features; and the reason is that both are essentially sea-deposits, characterised by calcareous rocks formed in the deep sea, and liable to admixtures of sandstone and shales along the shores. In such situations each is carboniferous. Both are highly rich in oceanic life, but during the formation of the oolitic rocks there is no proof that anywhere such excessive richness of vegetation was renewed on the land as that which yielded the mass of coal-plants in an earlier period. [OOLITIC SYSTEM.]

Cretaceous System.—The last portion of the series of secondary strata was deposited in the same oceanic basins as the earliest as far as Europe is concerned, but this is not the case in America. Generally in Europe the cretaceous rocks have their stratification parallel to that of the oolites, though some uncomformity in this respect occurs in Yorkshire and Dorsetshire; and in the south-east of France dislocations affected the oolitic strata before the production of the cretaceous rocks. But these comparatively slight movements of the bed of the sea appear totally insufficient to account for the complete change in the chemical and mineralogical character of the rocks, and the new orders of *Zoophyta* and *Mollusca* which date from the commencement of the cretaceous era.

Sands coloured green by silicate of iron, white soft limestones with beds or nodules of flint, seem to bespeak an origin from the waste of other lands than those which discharged other sands into the ooliti-ferous sea, and other modes of chemical or vital action in the sea; yet a scrupulous analysis of the oolitic system shows in its upper part analogies to the cretaceous rocks so strong and so various as to render it probable, if not certain, that the new conditions characteristic of the new system were gradually or partially introduced till they entirely predominated—for greensands alternate with the uppermost of the oolitic limestones in the Alps, flinty nodules lie in the calcareous grit and Portland oolite, and chalky limestones constitute the great portion of the latter rocks in some situations of England. It is to be regretted that we are so little able to determine upon good evidence what the new conditions influential on the deposits of the cretaceous rocks were; for their effects are very similar along a great range of the Atlantic coast of North America from New Jersey to the Mississippi, and throughout the interior of Europe.

The cretaceous period was not ended in England by dislocations situated in or even near that part of the surface. In Ireland eruptions of basalt of enormous extent cover the chalk, and indicate a crisis of volcanic disturbance. In France, Elie de Beaumont refers to the concluding part of the cretaceous period dislocations which range north-north-west in the Jura, and traverse the primary mass of Mont Viso. After the chalk formation was completed in the south of France the Pyrenees were uplifted to a great height, so as to limit the tertiary basins of the south of France; and it is supposed that at the same time the Apennines and the Carpathians experienced an upward movement. Conjecture has even joined to these the Alleghanies; but it may be gathered from Professor Rogers's reports on the geology of America ('British Association Reports'), and accordant notices of Featherstonhaugh and other competent geologists, that an earlier date should be allowed to that mountain range. [CHALK FORMATION.]

Tertiary Periods.—In general no contrast can be more complete than that between the secondary and the tertiary stratified rocks: the former retaining so much uniformity of character, even for enormous distances, as to appear like the effect of one determined sequence of general physical agencies; the latter exhibiting an almost boundless local variety, and relations to the present configuration of land and sea not to be mistaken. The organic bodies of the secondary strata are obviously and completely distinct from those of the modern land and sea; but in the tertiary deposits it is the resemblance between fossil and recent kinds of shells, corals, plants, &c., which first arrests the judgment. In general there is a decided break between the two groups of rocks—a discontinuity which is nowhere completely filled. Yet, besides the pseudo-tertiary or transition chalky rocks of Maestricht and the Pyrenees, and the conchiferous marls of Gosau, we have in England and France above the chalk a prevalence of green and ferruginous sands extremely similar to those below. Perhaps they have been derived from the waste of these older rocks: Sir Charles Lyell supposes the tertiaries of the London basin to have been formed from the waste of the secondary strata of Kent, Surrey, Sussex, and Hampshire.

With the tertiary system came into existence (if we may trust the negative evidence which the earlier strata present) many races of quadrupeds, some birds, reptiles, and fishes, extremely analogous, though for the most part specifically distinct from the modern denizens of land and water; thousands of corals, shells, *Crustacea*, &c., which present with living races quite as great analogy as obtains between the tribes of the Atlantic and the Pacific oceans of our day; the general features of land and sea as they now exist begin to appear, and there can be no doubt that in a philosophical study of the revolutions of the globe the tertiary era of geology cannot be properly separated from the existing system of nature.

Yet during the deposition of these rocks the relations of land and sea were greatly altered in Europe by the rising of the Pyrenees beyond the height they reached after the cretaceous era, and by the uplifting of the Alps from the Mediterranean towards Mont Blanc. In England we may believe the upward movement of the southern counties, connected with the Hampshire axis of elevation and the Isle of Wight convulsion, was ended before the close of the tertiary period. The eastern range of the Alps from Mont Blanc to Vienna is of later date, and may be viewed as the most marked phenomenon of elevation which accompanied or preceded the dispersion of erratic rocks in Europe. [TERTIARY SYSTEM.]

The following table, from Professor Ansted's 'Elementary Geology,' gives a summary view of the various strata of the earth, arranged according to the latest authorities, and also gives the foreign equivalents of the various British rocks:—

Table of Classification of Rocks.

TERTIARY EPOCH.

British.	Foreign Equivalents or Synonyms, and chief Foreign Localities.
Modern Deposits:—	
Raised beaches Peat bogs Submerged forests Deposits in caverns Shell marls	Similar appearances in Northern Europe, Siberia, and America.
Newer Tertiary, or Pliocene Series:—	
1. Upper gravel and sand 2. Till 3. Mammaliferous crag 4. Fresh water sand and gravel	These beds or their equivalents are known in various parts of Northern Europe or America. Other but very different deposits are the newer beds of Sicily. Others again are found occupying a large part of South America.
5. Red crag	Subappenine beds. Brown coal (of Germany). Belgian tertiaries (crag). The Sivalik beds (India) are supposed to belong partly to this period.
Middle Tertiary, or Miocene Series:—	
6. Coralline crag	Touraine and Bordeaux beds. Part of the Molasse of Switzerland. Vienna basin. Certain European, Asiatic, North African, and North American beds.
Lower Tertiary, or Eocene Series:—	
7. Fluvio-marine beds 8. Barton clays 9. Bagshot and Bracklesham sands 10. London clay and Bognor beds 11. Plaster and mottled clays, sands, and shingles	Paris Basin. Central France. Molasse of Switzerland (lower beds). Belgian tertiaries. Various beds in Western Asia and India. Various beds in North and South America. Nummulitic beds.

SECONDARY EPOCH.

British.	Foreign Equivalents or Synonyms, and chief Foreign Localities.
Cretaceous System:—	
12. Upper chalk with flints 13. Chalk without flints 14. Lower chalk and chalk marl 15. Upper greensand 16. Gault Lower. 17. Lower greensand Lower. a. Kentish rag Lower. b. Atherfield clay Lower. Speeton clay	Scaglia limestones of the Mediterranean. Maestricht beds. Senonian division of D'Orbigny (Craie blanche). Turonian beds of D'Orbigny, (Craie tufau); Quadersandstein of Germany. Albian beds of D'Orbigny. Plänerkalk of Germany. Neocomian of Switzerland and France. Hilsthon of Germany. Pondicherry beds. Bogota beds, South America. (?) Aptian beds of D'Orbigny. (?) Hils-conglomerat of Germany.

Wealden System :—	
18. Weald clay	Near Boulogne.
19. Hastings sand	North of Germany.
20. Purbeck beds	
Oolitic System :—	
Upper. 21. Portland stone	Jura limestone is the usual continental synonym of our oolitic series.
a. Limestones with clay and cherty hands	Lithographic limestone of Blangy.
b. Siliceous sand	Honflenr clays.
22. Kimmeridge beds	Solnhofen beds. Beds in South of Russia and in India.
Middle. 23. Coral rag and calcareous grits	Nerinean limestone.
24. Oxford clay	Argile de Dives.
a. Stiff clay	
b. Kelloway's rock	
Lower. 25. Cornbrash	Étage Bathonien is the name given by D'Orbigny to our lower oolites.
26. Forest marble	Calcaire à polypiers.
27. Bradford clay	Calcaire de Caen.
28. Great oolite	
29. Stonesfield slate	
30. Fullers' earth	
31. Inferior oolite	
Liassic System :—	
32. Alum shale	Calcaire à gryphites.
33. Marlstone	
34. Lower lias	
35. White lias	
Upper New Red-Sandstone, or Triassic System :—	
36. Bone-bed of Aust Cliff	Keuper marls, or Marnes irisées.
37. Variegated marls, with salt and gypsum	Muschelkalk.
38. Variegated sandstones	Bunter sandstein, or Grès bigarré.

PALÆOZOIC EPOCH.

Magnesian Limestone, or Permian System :—	
39. Magnesian limestone	Zechstein.
40. Dolomitic conglomerate	Kupfer Schiefer and other shales.
41. Lower new red-sandstone	Rothe-todte-liegende.
Carboniferous System :—	
42. Coal measures	The coal-measures occupy an important place in various parts of the continent, in Belgium, France, the Rhine, South Russia, and also in North America; in various parts of Asia, and in Australia. The foreign synonyms are, Steinkohlengebirge, terrain houillier, terrain carbonifère, and terrain anthraxifère.
a. Gritstones	
b. True coal-measures	
c. Fresh-water limestone of Burdie House, near Edinburgh	
43. Millstone grit	The millstone grit is generally a bed of subordinate importance out of the British Islands.
a. Coarse gritstones	The Kiesel Schiefer of Germany is an equivalent of the carboniferous limestone.
b. Laminated shales	The Belgium limestone beds and others in Northern Bavaria are in the same part of the series.
44. Carboniferous limestone	
a. Bands of fossiliferous limestone	
b. Shales (calp, culm)	
Devonian, or Old Red-Sandstone System :—	
45. Quartzose conglomerates (old red-sandstone) in South Wales and Scotland; represented by coarse red flagstones and slates in Devonshire and Cornwall	Devonian beds are well known in Belgium, the Eifel, Westphalia, and North Bavaria. In Russia the old red-sandstone appears, and contains similar fossils to those found both in the corresponding beds in the British Islands, and also in Devonshire and Herefordshire. The paleozoic beds of Australia are supposed to be contemporaneous.
46. Cornstone and marl of the old red-sandstone. Calcareous slate, limestone, sandy beds, and conglomerates of Devonshire and Cornwall.	
Upper Silurian Series :—	Silurian strata extend over much of the northernmost parts of Europe, and corresponding latitudes in America. They have been found in Brittany, in Westphalia, near Constantinople, and in Asia Minor. In South Africa, the southernmost parts of South America, Australia, and China, different contemporaneous rocks have been determined. In mineral character they are generally distinct from the English beds, but offer no marked characters uniformly present.
47. Tilestone	
48. Ludlow group	
a. Upper Ludlow shales	
b. Aymestry limestone	
c. Lower Ludlow shales	
49. Wenlock group	
a. Wenlock limestone	
b. Wenlock limestone	
Lower Silurian series :—	
50. Caradoc sandstone	
51. Llandeilo flags	

We may now turn to the consideration of the present aspect of the globe.

According to every view of geological causes and effects, the present aspect of our planet is the result of all its previous changes; these changes cannot be completely understood if we leave out of consideration the daily variations which occur in the condition of the earth, nor can the operation of existing agencies be completely represented to our minds without calling in aid the inferences derived from a study of earlier phenomena.

One of the most important things ascertained by geological investigation is the certainty that the operations by which stratified rocks were formed in the sea-bed, and the igneous rocks uplifted from below, were repeated nearly in the same succession over most parts of the globe. Some of the formations are very extensive: in all countries the lower strata are of the character of gneiss, mica-schist, slate-rocks, &c. These primary strata may almost be termed universal: the organic forms which they contain, though few, are very similar, or exactly identical, over enormous areas; and there can be no doubt that during the deposition of these ancient rocks the earth enjoyed an uniformity of conditions over its surface never since repeated. There is no proof that land existed anywhere in the earlier part of this period—no probability that any part of our continents or islands then stood above the water. At the close of the primary period the effect of elevatory forces was manifested by the existence of some narrow ridges and peaks of rocks, corresponding to some of our present mountain tracts, as the Grampian and Cumbrian mountains, and of others now vanished, which nourished the forests and herbs whose destruction has yielded coal.

Through the secondary period this elevation of land proceeded gradually, or by intermitting action, till at the close of that period some of the principal features of European geography were visible; the ocean was contracted and divided into many basins and gulfs, some of which remain, as the Adriatic, English Channel, German Sea, &c.; while others, as the Vale of the Danube, Sea of the Rhine, &c., have been dried by further elevation.

The same elevatory action continued through the tertiary eras completed the geographical features of Europe, and though we cannot trace so minutely in other parts of the world the contemporaneous changes, enough is known to assure us that the same causes have, within the same general limits of time, produced, in all quarters where dry land appears, the same phenomena.

In the preceding pages we have spoken of the elevation of land from the sea as a thing perfectly well understood, and admitted as a basis of reasoning. It is so admitted by geologists of every shade of opinion who wish to explain effects by real causes. We shall here present a short sketch of the reasons which have produced on this important point so general an agreement among geologists.

1. In existing nature the combined influence of the exterior and interior causes of change cannot materially affect the level of the sea (as estimated by the mean radius of its surface). Within sensible limits the sea-level is now permanent. 2. The land now above the waters was formerly below them, and could only have been laid bare by the elevation of parts of the sea-bed, or by the abstraction of the ocean to other regions, either through depression of its bed or through a displacement of the axis of rotation, or by an universal diminution of the quantity of water on the globe, or by a change of the oceanic level through great alterations of temperature at the surface or through the mass of the globe.

In examining these possible modes of desiccation of land, geology must have recourse to collateral science. The two last hypotheses, namely, of a change of oceanic level, without change of external form or axis of rotation, are insufficient for the purpose. Sound reasoning rejects the supposition of an indefinite waste of oceanic waters for miles in depth, because the position of our planet in space yields no escape for the water; nor is there any ground for believing that the quantity fixed in mineral compounds since the date of the earliest strata is of much importance. A general change of temperature of the globe would certainly alter the relative level of land and water, because their rates of expansion and contraction are unequal. Between the boiling heat, 212°, and what is probably below the mean temperature of the actual seas, 40°, the contraction of the water would be about ·042 of the whole quantity. The land certainly would contract less, and thus by a general cooling of the globe the ocean-level would relatively sink. To put the case to extreme, we shall suppose the contraction of the land = 0, the area of the water to remain unchanged, and the mean depth of the sea ten miles; the reduction of level of the ocean would be $\frac{42}{100}$ of a mile = 739 yards. Now, as all the conditions of the problem have been taken in extreme, as the deepest part of the sea probably does not exceed ten miles, as one quarter of the spherical surface is land, and the area of the sea must diminish as its level sinks, it is very obvious that the greatest possible change of oceanic level from this cause could only go to one, two, or three hundred yards at most; and therefore it is impossible by such means to explain the desiccation of land from 1000 to 10,000 or 20,000 feet high.

Moreover, during this cooling of the land and sea the whole globe would contract; and from this cause the mean radius of the ocean diminish and its mean depth augment, so as to reduce still more the possible extent of land that could be drained by its change of dimensions.

The attraction of the ocean to other regions would lay dry parts of its bed; and if astronomical science permitted geologists to change at their pleasure the position of the axis of rotation of the earth, few difficulties need stop the career of speculation; but the earth is a spheroid of revolution, and if the attraction of the heavenly bodies in the various positions which it takes with regard to them does not disturb its axis of figure, neither can it be thought that the volcanic fever of its surface can so alter the interior densities as to cause any sensible change in this respect.

But that the bed of the sea may have sunk, that other continents than ours may have fallen below their ancient level, may be assumed as readily as the rising of the existing land, but with this restriction, that the sinking of the bed of the sea requires to be far greater than the rising of the land, because three-quarters of the globe are covered by water, and thus a small difficulty is overcome by introducing a greater.

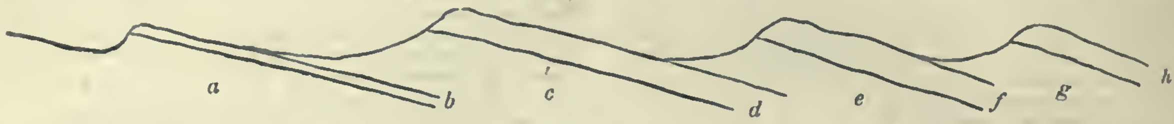


Fig. 4.—*a*, Red marl; *b*, lias limestone; *c*, lias clays; *d*, lower oolite formation; *e*, Oxford clay; *f*, middle oolite formation; *g*, Kimmeridge clay; *h*, upper oolite.

Finally, on turning to the phenomena connected with mountain chains, it is perfectly certain from the position of the strata—often vertical or contorted in the sides of chains, highly inclined near them, and gently sloping at greater distances—that these rocks have been displaced by an elevating force acting from below. The direction of the force, the geological time of its occurrence, its sudden or gradually accumulated intensity, and many other characteristic circumstances, can be determined; and upon the whole no doubt remains that elevating movements have raised the land, and there is no reason to deny that depressing movements may have sunk the bed of the sea.

Throughout all the globe the outlines of land and sea depend principally on the disposition of mountain chains and groups, which in every instance yet known are certainly shown to have been raised by mechanical agency, generally with a degree of violence so great as to require the supposition of great and general excitement of the subterranean forces of heat. America, for instance, derives its form from the chains of the Andes and Rocky Mountains, the littoral range of Brazil, the Alleghanies, &c., mountains probably of very unequal antiquity. The Ghauts define the western side of India, as the Atlas mark the north-western border of Africa; the Pyrenees and Sierras give the form of Spain; the Cornish, Welsh, Cumbrian, Lammermuir, and Grampian ranges explain the figure of England and Scotland.

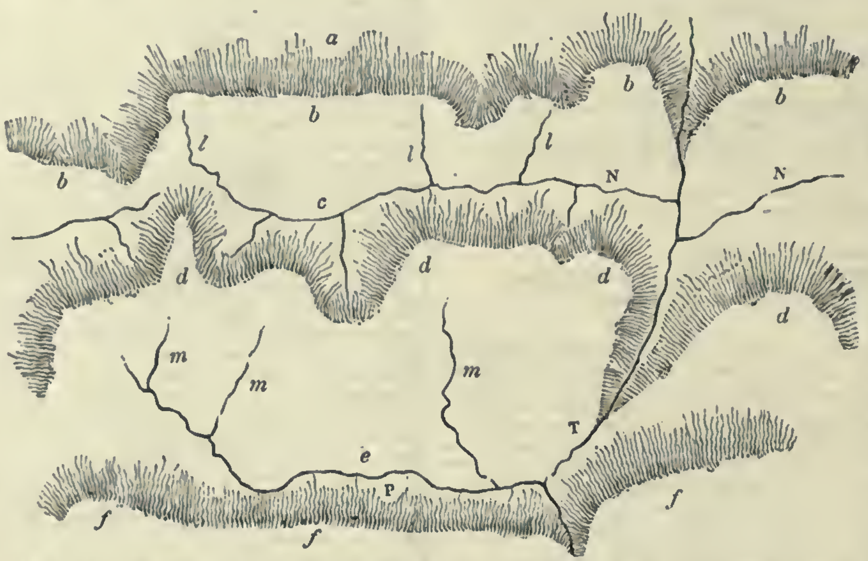


Fig. 5.—*a*, *b*, *c*, *d*, *e*, *f*, have the same meaning as in *Fig.* 4; *l l l*, *m m m* valleys which descend with the slope of the strata, here supposed to dip south; NN, and P, longitudinal valleys, or such as run parallel to the outcrop of the strata; T, a transverse valley, uniting the longitudinal ones.

Fig. 6.—The letters have the same signification as in *Figs.* 4 and 5.

Frequently however this dependence of the form of the existing land upon the ranges of mountains is disguised by the extent of comparatively plain country which separates the mountains from the sea. Thus, all the eastern half of England might seem to have its form independent of the narrow ridges of the western mountains; and it is but a vague relation which links the Baltic, the Black Sea, and the Caspian to the Harz, Saxon, Carpathian, Caucasian, and Uralian chains. In these and many other cases it is necessary to admit that the general level of the sea has subsided, or that large tracts of land have been raised gradually, or by successive movements round the mountains, which in earlier times were uplifted by more violent effects. The diagrams, *figs.* 2 and 3, illustrate the fact of the general slope of the English strata from the western mountains; but this cannot be explained by the violent elevation of these mountains, for this happened principally before the deposition of the coal strata. A large area round these mountains has since been gained from the sea by more gradual changes of level.

Similar phenomena present themselves in detached areas all over the world; but in very unequal degrees, and with unequal differences of level above the ocean, even in neighbouring tracts. It appears therefore more probable that particular regions have risen round the same points and lines which once experienced a violent upward movement. There is no reason to deny that the ocean-level may have been somewhat lowered by the subsidence of a part of its bed; but it has been already shown that no reasonable (perhaps no possible) sinking of the ocean-bed could explain the phenomena of the desiccation of even the flatter parts of the land.

The interior features of every country, in like manner, depend upon recognised geological agencies. The unequal elevation of mountain ranges above the sea is a phenomenon which will be found of great importance in geological theory. It appears to be true, at least in Europe, that the most elevated chains of mountains are those whose elevation was not ended (if, indeed, it be yet ended) until the tertiary or later epochs. Thus, the Alps, which bear on some of their heights (Diablerets) caps of tertiary strata, ascend to 15,660 feet above the sea; the Pyrenees, whose principal elevation appears to have followed soon after the chalk, to 11,270; the Carpathians, nearly of the same date, to 8675 feet: while in the Harz the older mountains (Brocken) rise to 3739 feet; in Wales (Snowdon) to 3675 feet; in the Grampians (Ben Nevis) to 4350 feet. The highest point of Norway (Schnee-Haten) is more than 8000 feet above the sea, but there can be no doubt that violent as well as gradual upward movements affected the Scandinavian ridges to a late geological era.

Raised in this manner by violent or gradual movements out of the sea, the dry land has since been subjected to waste by atmospheric action; and there is no doubt of the truth, that to different sorts of rock belong some differences of aspect, some characteristic scenery. The forms of the hills and valleys are not the same in the gneiss and mica-schist of the Grampians; the clay-slate ranges of Wales; the limestone of Derbyshire; the oolites of Gloucestershire; the chalk of Wiltshire; even single rocks and waterfalls have distinctive characters, and the whole aspect of a country changes with its geological structure. It thus appears that the nature and structure of the rocks, their elevation above the sea, and the manner in which they attained it, and the intensity and duration of the atmospheric agencies which have since affected them, are the elements which determine in every instance the physical aspect of a country.

No question in geological theory has been the subject of so much debate, with so little of correct reasoning, as that of the origin of valleys. By Dr. Hutton it was contended that atmospheric agency and running waters had excavated valleys; by De Luc the subsidence of the crust of the earth was invoked; Omalius D'Halloy introduced the consideration of dislocations on the line of the valley; and Dr. Buckland appealed to the overwhelming force of a general flood. None of these views is entirely wrong; each contains partial truth; and the complicated problem of the inequalities of the surface of the earth can be solved by combining them.

By violent elevation from the sea, rocks of whatever nature or structure, must have been variously broken and fissured. It is conceivable that some of these fissures might descend below the level of the water. During the elevation some considerable effect on the forms of the ridges and hollows would be produced by the agitated water, but the smaller modifications which they have experienced must be ascribed to atmospheric agency. In these few words we have the history of the rough hills, abrupt valleys, and deep lakes which belong to mountain chains like the Grampians, Alps, and Pyrenees.

By gradual risings or interrupted lifts of the bed of the sea, other phenomena would arise; the action of the sea upon the rocks, successively brought within the sphere of its littoral movements, would concur with the form of pre-existing land, and the entrance of its drainage waters, in extending the old and producing new valleys.

In the next diagram (*fig.* 6) the same country is represented as rising out of the sea, which penetrates by the transverse valley across the ridges of rocky hills, and flows round them up the vales of clay; its waves wasting the clays under the cliffs, and causing the top to fall, exactly on the same principle that waterfalls at this day, by wasting the argillaceous basis, break down the crowning limestone beds throughout all the north of England.

The Giesbach, on the lake of Brienz, compared with the Staubbach; Hardrow Force in Yorkshire, or Ashgill Force in Cumberland, contrasted with the Fall of Lodore, near Keswick, are in this respect very instructive; nor should the cases be neglected where, as on the coast near Scarborough, Robinhood's Bay, and Whitby, the sea now flows among the lias and oolitic rocks, and wastes their argillaceous parts on a small scale, almost exactly as in the above explanation it is supposed to have wasted the similar but thicker clays, when the whole system was rising above the waves. Pleasing illustrations of this kind of action occur in the Medlock at Manchester, the Greta near Ingleton, the sea-coast near Heysham, Sunderland, Berwick, &c. In the Isle of Wight the fresh-water limestones and clays, and the various beds of the plastic clay series about Culver, offer abundance of curious examples.

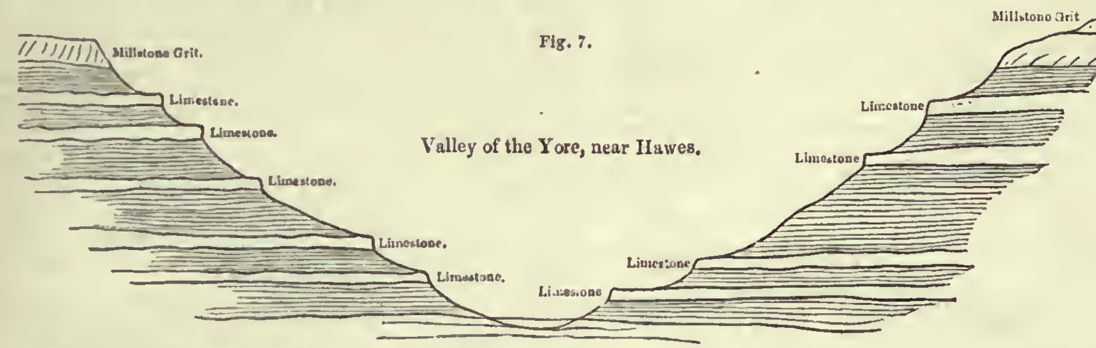
The same mode of action is traced in the forms of mountains and hills which are composed of strata of unequal resisting power; as mountain limestone and shale in the Yorkshire dales, oolite and clay in the Gloucestershire Hills, Normandy, or the Jura mountains.

The diagram (*fig.* 7), given below, represents a cross-section of Wensley Dale, which for a great part of its length exhibits, wherever a considerable rock of limestone comes to the surface, a decided projection and terrace on the hill side, and below every such rock a slope formed in the alternating shales and thin sandstones.

How much of this appearance is due to atmospheric action and rain since the river Yore has been running in its present bed, and how much to the influence of water bathing the hill-breasts at higher levels, is not easy to determine; but the correspodence of the strata on the opposite sides is such as to leave no doubt that all the vast space of the valley has been really excavated out of continuous strata; and the survey of the whole line of this and other rivers appears to refute the opinion that the existing drainage waters have carried off much of the detritus.

To conclude this brief notice of the origin of the principal inequalities on the earth's surface, it may be proper to remark that the view here given of the excavation of valleys at the time of the rising of rocks from the sea, explains the otherwise unintelligible phenomenon of dry valleys in chalk, oolite, and other calcareous strata, which

Fig. 7.



Valley of the Yore, near Hawes.

The greater number of these extended or new valleys would be directed at right angles to the axis of elevation in progress, and therefore, on the dry land, the greater number of valleys originating in these circumstances will be found to run with the dip of the strata. How exactly this agrees with the general character of the drainage channels of the secondary strata of England above the red-sandstone requires only to be mentioned; and it has been already shown that in all the south-eastern parts of England where these strata occur there is sufficient evidence that the elevation of these rocks was due to gradual and long-continued, not violent and transitory movements. While such gradual movements occurred, and strata of unequal hardness and different structure (as limestone and clay, or sandstone, in diagram, *fig.* 4), were brought within the range of littoral action, these would be unequally affected by the tidal and other currents; the softer parts would be worn away, the harder remain; and thus the red marl would be wasted parallel to the coast-line, or to a certain depth in the water, below the cap of lias limestone; the lias clays would yield beneath the crown of lower oolite; the Oxford clay be excavated below the middle oolite; and the Kimmeridge clay form a vale between the middle and upper oolites.

The exact conformity of this with the appearance in nature is well known. The general character of the actual drainage, as Dr. Smith has often and elegantly explained, may be represented in diagram, *fig.* 5, where *l l l* and *m m m* are valleys descending on the slopes of the strata, N N and P, valleys formed in softer strata parallel to the coast; T a transverse valley uniting the others.

wind and unite like the branches of a river, and have slopes and features such as to prove their origin from moving water, but contain no trace of a stream, no mark of a spring, and often no alluvial sediment.

It appears also necessary to remark that, independent of the facts here stated, there must be some importance attached to the effects likely to be produced by the violent agencies, whatever they were, to which the origin of diluvial phenomena is ascribed. The essential thing however in this case being a relative change of level of land and sea, the result of the watery agitation could only be to modify in a greater or less degree the more considerable effects of previous agencies of longer duration. Gravel heaped in particular places conceals some of the earlier slopes of land, and covers with irregular hillocks an original sea-plain, but the great features of the country remain comparatively unaffected by these transient disturbances.

Life on the Globe.—Geology enables us to behold, in the present varied and complicated arrangement of land and water, the result of many and repeated actions of causes which are not yet extinct, but continually occupied in similar operations, in different situations, and under different circumstances. The land which has been raised from the sea by internal expansion seems to be slowly wasted away by the action of water, and again restored to the deep. But new land is formed by these ruins, and volcanic fires are yet competent to raise or depress the bed of the sea.

The land is not all of the same antiquity; some regions must have been covered by trees, perhaps or rather certainly traversed by quadrupeds, before the substance of others was laid on the bed of the sea. Since life was developed on the globe, if geology has rightly interpreted the monuments of nature, there has never been any considerable period during which the land or sea was wholly deprived of organic beings; but as the condition of the globe changed, the forms of life were altered, old races perished, new creations were awakened, the sum of animal and vegetable existence was continually augmented, and the variety of their forms and habits continually multiplied, as the conditions of land and sea were diversified, until man was added to the wonders of creation, and historic time began.

If then, through all past geological time, organic life has changed its aspect as physical conditions varied—if the present physical aspect of the globe is derived from previous physical revolutions, must we look on the present system of organic being, adapted to the present physical conditions, as similarly derived by corresponding revolutions from earlier systems of life, corresponding to earlier states of the land and sea?

If the physical aspect of the globe is now changing, does its organic enrichment vary likewise; or is the relation of organic life and physical condition one of coincidence merely—one of those adjustments independent in its nature, though associated in time and situation, which offer the most convincing proof of continual superintendence of the divine lawgiver of nature?

Though we cannot here enter at large on a subject which requires the details which are found under another head [ORGANIC REMAINS], there are points of too general importance, in reasoning on the present condition of the globe, to be wholly omitted:—1. The relation of form and structure between the living and extinct worlds of life; 2. The distribution of the existing forms of life, in reference to the geographical features and geological history of different parts of the globe.

The relation of living to extinct races of plants and animals is various. In number, the Recent Flora is perhaps 100 times as considerable as the Fossil Flora, and though this is in some degree owing to the circumstance that land-plants, insects, &c., must necessarily be comparatively rare in marine strata, yet the vast number of individual plants accumulated in coal tracts does not appear to justify a very high estimate of the variety of specific forms of plants in early periods. The same is true of the marine races of shells, *Crustacea*, fishes, &c.; for both the total number of species, and the relative number to a given thickness of strata, augment from the early towards the later formations, and are greatest of all in the tertiary strata, which in character of organic life most nearly resemble the modern productions of nature.

On comparing the living with the vanished tribes of plants and animals, we are struck with the fact that hardly one species of the fossil kingdom is so peculiar in its structure that nothing at all like it is now in existence. Recent analogies of extinct forms are continually and unexpectedly presented to us by the attentive voyagers who now explore the most remote and unknown regions of the land and sea, and continually revealed to us by the discoveries of comparative anatomy, which detects in common forms traces of analogies to extinct creations formerly altogether unsuspected. Thus the belemnite, the trilobite, the ichthyosaurus, are reduced to their proper station among *Mollusca*, *Crustacea*, and *Reptilia*, and the whole extinct and living world of nature becomes united into one general system.

But this indubitable affinity between the plants and animals now living and those which adorned the world in earlier ages does not require us to adopt the speculations of Linnæus, Oken, Lamarck, St. Hilaire, and the anonymous author of the 'Vestiges of the Natural History of Creation,' that specific forms of plants and animals are no further permanent than the circumstances which surround them; that as these change those vary; that the immense variety of organic structure may have been derived from a few primitive types—the living gavial from the fossil *Teleosaurus*, the living cuttle from the fossil *Belemnosepia*, the living from the fossil *Equiseta*. This doctrine, plausible as it seems, and flattering as it is to that propensity in man to derive everything from a beginning of which his own senses may give some notion, must be rejected for three reasons:—

1. In existing plants and animals the experience of mankind, for 2000 or 3000 years, has shown no essential change.

2. There is no proof, drawn from examination of fossil reliquiæ, of this assumed change from one species to another, much less from one genus to another. On the contrary, it is a very striking truth, illustrated in almost every group of fossils, that while the same species retains through many deposits of different age its essential characteristics, new ones come into view in many of these strata, not by a gradual change, but by a sudden development.

3. The destruction of old races and the introduction of new appear in many cases to have been sudden and complete, at least locally.

In considering the distribution of existing forms of life, with reference to the geographical features and geological history of different parts of the globe, we cannot avoid being struck with the fact that each species, each genus, and often each family, of plants and animals, is especially abundant in and often exclusively confined to particular parts of the land or sea, even among those animals whose powers of locomotion are the greatest. Among fishes, birds, and swift quadrupeds, this attachment to locality is scarcely less remarkable than among Plants, Zoophytes, and *Mollusca*, which have no means of diffusing their races, except what winds and currents give. It has therefore become an admitted truth in the philosophy of natural history, that there are certain regions of the land and tracts of the sea for which particular groups of plants and animals were specially created, and to which for the most part their existence is still confined.

The living species of plants and animals which most nearly resemble fossil races are variously distributed over the globe. Tree-ferns, gigantic *Equisetaceæ*, and other plants illustrative of the Flora of the carboniferous period, may be found in Brazil, the Indian Islands, and Australia; coniferous plants occur in colder latitudes, or at greater heights in the tropics, as well as in the lias; *Cycadaceæ* occur in South Africa and Australia, and tropical America, as well as in the oolites. The recent *Trigonia* and *Cerithium giganteum* are found on the Australian shore; *Pholadomya* was washed on the island of Tortuga: and *Cucullæa* belongs to the Indian Ocean. *Lingula* is found in the Moluccas; but *Terebratula* in all seas: the nearest living form to the old fossil crocodiles inhabits the Ganges; while the bony pike, whose scales resemble those of *Megalichthys*, lives in Lake Ontario.

Geological Time.—There is perhaps no more difficult problem in geology than the determination of the length of time which has elapsed during the formation of the whole or any definite part of the crust of the earth. Time, as measured by generations of men, fails to carry us back to remote geological epochs; man is but a recent visitor of the globe; compared even to the secondary strata his date is of yesterday, for all the existing forms of life cease with the lower tertiary rocks, only small proportions of them occur in the middle of that series, and traces of men have nowhere been seen in any but the most modern parts of the stratified masses of the globe. If then the history of the human race does not commence till after the deposition of at least the greater part of the tertiary strata, by what rules shall we attempt to compare the few thousand years of his existence with the earlier periods of the history of the globe?

In a vague sense, nothing appears more obvious than the conclusion universally admitted among geologists, that the earth is of vast antiquity, yet nothing more eludes the grasp of reasoning than the seemingly easy task of computing its age. The rocks are indeed full of monuments of time, "rudera longinqui seculm præterlapsi ævi," but we have not yet learned fully to decipher them.

When we behold thousands of strata piled on one another in a regular series, each distinct by some peculiarity from the others; when we find among these the original products of chemical action (as limestone), the slow sediments from gentle motion (clays), rough sand and pebbles implying greater agitation; how can we refuse to admit that long time elapsed during the often repeated change of chemical and mechanical agencies of water over the same portions of the bed of the sea?

When among these strata we observe the remains of plants and animals, various in their kinds, regular in their distribution, so as to prove that at successive times the same part of the sea nourished successive races of animals, and buried in its sediment distinct races of plants, where in modern nature is it conceivable that such repetitious of change, in all the ranks of creation, could take place except by the aid of almost immeasurable time?

Descending to minuter inquiries, we find some particular strata composed of fragments derived from a more ancient rock, which after being deposited in water, was indurated, raised to the surface, wasted by drainage, and again collected in rolled fragments on the bed of another sea. The trees which are imbedded in certain rocks (coal-measures, lias, Portland oolite, &c.), are often known by their rings of growth to be some decads of years old, and in particular cases (Dirt-bed of the Isle of Portland) it is supposed that their whole existence passed between the formation of two beds of stone.

Every country affords examples of certain fossil shells confined to even a thin layer of shale, sandstone, limestone, or ironstone, and in some instances (near Leeds and Bradford) the youngest embryo *Goniatites* and the oldest full-grown shell are found in one bed of 6 or 12 inches thickness, in that alone, and apparently in the place of their quiet existence, so as to indicate that the lifetime of that *Goniatite* (*G. Listeri*) was consumed during the accretion of one calcareous bed, which is about $\frac{1}{3000}$th part of the thickness of the coal-measures whose history it enriches.

If again, among those strata produced by watery action we find alternations of volcanic rocks, and learn that at particular epochs in the series of deposits mountains were raised from the sea, land clothed with forests was submerged, and the physical geography of particular regions entirely changed, we see clearly that such repeated revolutions of nature agree with the history of the organic creations in refuting the narrow views of those who would limit the age of the world to the short annals of mankind.

But how are we to proceed further, so as to clothe with a more philosophical character these almost poetic notions of the immensity of past geological periods? Three orders of effects are in this respect important:—

1. The deposition of stratified rocks. 2. The changes of organic life on the land and in the sea. 3. The displacements of land, and changes of physical geography.

The phenomena of stratification are at this day repeated, and on a very considerable scale, in most parts of the world. Where great rivers sweep earthy materials and vegetable reliquiæ to the sea, as in the case of the Mississippi, Amazonas, Rhine, the Po, and other rivers, littoral aggregations take place, and new land is formed; tides and currents throw up sand-banks, or disperse the finer sediment far from the shore over the quiet bed of the ocean. From the growth of new land on the Adriatic and Egyptian coasts, by the action of the Po and the Nile, some notion may be formed of the great quantity of sediment annually transported by rivers to the sea, and both reason and experience show that the materials are there accumulated in the same manner as the ancient strata were.

But are they now accumulated with the same, with greater, or less rapidity? If equal deposits are now formed in equal times, the calculation of the age of the visible crust of the earth is as easy as it would be philosophically useless; but to assume this principle is to nullify the conclusion from it. Unless it can be shown, à priori, that atmospheric influence must have been constant through all past geological time, the assumption will not be accepted. This cannot be satisfactorily shown, for the external excitants on which the atmospheric actions depend contain variable elements. No certain conclusion then can be rested on the comparison of the mere thickness of the stratified rocks, as to the lapse of time, unless there can be found an independent scale of time which may help to interpret the other.

Such a scale of time is perhaps contained in the series of organic beings imbedded in the earth. These belong to many successive systems of life, which may be compared with the existing forms of nature, and could we establish from history any rate of change in organic life, any per-centage of species destroyed, or created in a given series of years, some considerable steps might be laid for further advance. But two or three thousand years appear to have made no change on quadrupeds, birds, reptiles, fishes, shells, or conspicuous plants. As far as can be known by study of old writers on natural history, sculptured monuments, coins, and mummies, no change of external form or internal structure has been experienced since the earliest historical era; the loss of a very few species is all that can be safely admitted; and no proof is offered of a single newly-created form, though the distribution of the different groups of plants and animals has been varied by sea-currents carrying seeds and ova, and altered by man, who has learned to conquer by obeying nature.

As far therefore as the more obvious and characteristic forms of animals and plants can be admitted to yield satisfactory evidence, the period of two thousand years since the days of Aristotle would be insufficient even as a unit of measure by which to estimate the intervals of geological time which elapsed during the deposition of strata. This conclusion is strengthened by some and weakened by other considerations. It is weakened by the circumstance that the changes of organic life appear to have been sudden; it is fortified and illustrated in a powerful degree by comparing existing nature with the tertiary era, for thus the ten or more thousand shells of this day appear to be joined to an equal number of others, into one long series of definite organic forms, which, since the date of the chalk, have admitted new and lost old species continually. Whether these new species, in any particular basin of strata, were parts of one or more new creations there, or, as may perhaps be thought probable, transferred from other centres of oceanic life, is quite unimportant for the argument as to time. The effects resemble those noticed among the older strata, the causes must be assumed to be correspondingly similar, and the times must be in some degree proportionate. Uniting therefore the tertiary and modern eras into one great geological period, we may compare the unknown quantity of time which it includes with other equally unknown and older intervals in the history of the globe, corresponding to similarly complete series of organic forms. This comparison is facilitated by the remarkable fact of the almost total distinctness of the organic beings of successive geological periods. Had the shells of successive systems of strata been gradually changed by substitution, we should have been compelled to compare not systems but formations, or even individual strata; and the conclusions might have become irremediably obscure.

The systems to be compared are:—Tertiary, Cretaceous, Oolitic, Saliferous, Carboniferous, Fossiliferous, and Primary.

The following table, extracted from Professor Phillips's 'Guide to Geology,' gives the proportionate thickness and number of organic forms of these systems:—

Strata.	General thickness.	Number of species of organic remains to 100 ft. thickness.
Tertiary	2000 feet	141
Cretaceous	1100 feet	70·7
Oolitic	2500 feet	45·6
Saliferous	2000 feet	8·2
Carboniferous	10,000 feet	4·7
Primary	20,000 feet	2·0

Hence it is very obvious that any conclusions as to time, drawn from the mere number of species which were developed and destroyed with any system of strata, will be totally opposed to others based on the observed thickness of the strata. The inferences are obvious and important; the numerical relations of organic life to the amount of stratified deposits are variable; one cannot be used as a measure of the other; the variety and abundance of organic life has been augmenting from the primary to the tertiary eras, or the deposition of strata was in the early ages of the world fifty times as rapid as in the tertiary period. This latter conclusion can never be allowed, since the fossiliferous primaries show clearly their origin from land-floods and littoral currents, and these depend on influences which cannot be supposed to have varied in any such proportion.

It thus appears that neither the numbers of organic fossils nor the thicknesses of strata afford a perfectly satisfactory scale by which to measure past geological time; but whichever of them be preferred, the age of the world cannot be estimated at less than several times the whole tertiary period, and compared with this the historical portion of time, which dates from the birth of man, contracts to a point.

By uniting the two considerations above stated, it will appear certain that the rate of organic development has been augmented, and probable that the rapidity of sedimentary deposition diminished since the primary era; and it is no slight argument in favour of the hypothesis of a gradually cooling globe, that both these phenomena are natural consequences of it—for that the greater influence of the earth's proper heat in the earlier epochs would favour the mechanical but limit the vital activity of nature seems to require no proof.

If however independent proof were required of this change of ratio among the agencies of nature, we must appeal to a third order of phenomena most certainly characteristic of disturbances of the equilibrium of the earth's proper temperature: the fractures, contortions, and other marks of the violent elevation and depression of the crust of the globe.

From what has been already stated it is very clear that the principal phenomena of this description occurred specially at particular intervals during the long periods of geology; for example, after the primary period, after the carboniferous era, before and after the accumulation of the cretaceous strata, after many of the tertiaries were produced. Now, on comparing the amount of disturbance effected at these epochs respectively, we are unable to perceive that the efficient causes have diminished in force; for the elevation of the Alps in the tertiary period is apparently quite as conspicuous a phenomenon as can be found among older geological monuments. M. Elie de Beaumont, to whose speculation as to the geographical characters of subterranean movements allusion has already been made, supposes that as many as twelve distinct epochs of mountain-elevation may be recognised. The following is a brief summary of the classification which best suits the geology of England:—

Geological Period.	Effects noted.	Localities.
1. After the deposition of the Skiddaw rocks.	Beds of argillaceous conglomerates.	Derwent-Water.
2. During the deposition of the Snowdon rocks.	Porphyry, greenstone, and trappean conglomerates.	Under Helvellyn, in Snowdon, &c.
*3. After all the primary strata were deposited.	Principal elevations of primary rocks.	Grampians, Lammermuirs, mountains of Cumberland and Wales.
Conglomerate Rocks follow in the old red-sandstone.		
*4. After the deposition of the coal strata.	Immense faults, anticlinal axes, &c.	The great faults of Tynedale, the Penine chain, Craven, Derbyshire, Flintshire, South Wales, and generally of the coal districts.
Conglomerates follow in the red-sandstone.		
5. After the oolitic period.	Unconformity of stratification between oolite and chalk system.	Yorkshire, Dorsetshire.
*6. After the London clay.	Anticlinal axes and vertical strata.	Isle of Wight, Axis of the Wealden.

At the three epochs marked by stars, the most considerable movements and greatest changes in physical geography appear to have been produced. Such changes also occurred about the same epochs on the continent of Europe: the most universal of the phenomena seem to be the two earlier ones; but it is almost impossible in any case to prove that the occurrence of convulsions was synchronous at distant points. Since then we can neither affirm anything with respect to the change of force of the subterranean monuments at different geological epochs, nor can ascertain, except by reference to the phenomena of stratification and organic life, whether they occurred more frequently in one period than another, it is impossible to draw from the evidence of these disruptions any certain conclusion either as to the change of the earth's proper heat or the extent of geological time. If indeed the actual effects of earthquakes were to be placed against the mighty wall of the Penine fault, the vertical beds of the Isle of Wight, or the concealed dislocation of the coal-fields of Valenciennes, there would be no doubt of the decay of natural agencies; but this is not allowable, for the great dislocations alluded to are to be viewed as phenomena of a short interval of violent movements between long periods of ordinary action such as now obtains on the globe.

It may be supposed that the number of these cases of very great and extensive disturbance is in proportion to the time elapsed; but as none such has occurred within the reach of history for at least 4000 years, we see how very ancient is the earth; and further, we have no data for accurately computing in numbers the vast periods which have elapsed in producing the stratified crust changing many times its vegetable and animal races. On the whole, it appears that the day is not arrived for theory to trust itself with the attempt to assign definite values to the symbols of duration which remain in the earth. Long, undoubtedly, perhaps as long as the periods which the study of planetary motions has revealed, must be the whole range of geological time; but until we know at this day what is the average rate of deposition of sediment in the sea, or the usual age of marine *Mollusca*, until we can determine the numerical or structural relations between organic forms and physical conditions, or can convert the irregular effects of volcanic fires into a calculable series of changes of temperature, there is little hope that the invitation of the Royal Society, to assign the antiquity of the crust of the earth, will be accepted by prudent and competent geologists.

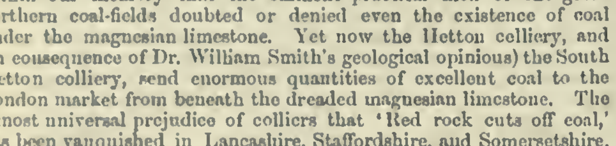
Economical Applications of Geological Science.—"Practice," says Professor Whewell, "has ever been the nurse of theory: art has ever been the mother of science, the comely and busy mother of a daughter of far higher and serener beauty. But the benefits are reciprocal; geology, at least, is capable of well repaying the large debt which it owes to the experience of the miner, the engineer, and the agriculturist, and indeed some of its truths are already largely productive of public benefit.

"There is hardly a district in this island where the reasoning of geology has not checked extravagant expenditure in search of coal or metallic ores where such are not to be found, and conquered the credulity of ignorance ever ready to listen to the delusive and almost superstitious notions of merely working colliers and miners. The false and deceitful promise of finding good coal by going deeper, will not often again lure the landed gentry and respectable companies to such adventures as sinking for coal in the oolites of Oxford, the sandstones of Sussex, or the silurians of Radnorshire. But it is not merely by preventing foolish and wasteful expenditure, in search of imaginary treasures, that geology has aided the mining interest: it is within our memory that the eminent practical men of the great northern coal-fields doubted or denied even the existence of coal under the magnesian limestone. Yet now the Hetton colliery, and (in consequence of Dr. William Smith's geological opinions) the South Hetton colliery, send enormous quantities of excellent coal to the London market from beneath the dreaded magnesian limestone. The almost universal prejudice of colliers that 'Red rock cuts off coal,' has been vanquished in Lancashire, Staffordshire, and Somersetshire, and reasons have been given by Conybeare and others for believing that under the red rocks of the midland counties great tracts of coal remain for the public advantage and the triumph of geology." ('Phil. Mag. and Annals.')

Some years ago, Lord Dartmouth, guided by geological reasoning, in opposition to the views of the local colliers, sunk a trial pit for coal near Birmingham, and found it below red-sandstone rocks. It was faulty near the pit bottom; but this has not prevented the establishment of a colliery, nor discouraged further attempts in the vicinity.

Coal-working.—In the practical department of coal-working, geology can as yet render little aid, because the experience of the coal districts has hardly yet been turned into science. The subject of the 'faults' ('troubles,' as they are often and justly called), from which no coal-field is exempt, and which by their effects on subterranean drainage, and the disarrangement of the subterranean works, their influence on the quality of the coal, and other circumstances, are of the highest importance to the collier, is yet almost wholly unknown as a branch of science. One general fact known concerning them (the correspondence of the dip of the fault to the depression of the strata), may be illustrated in the subjoined diagram after Professor Phillips's.

Fig. 8.



In this figure the faults *a*, *b*, and *x*, decline variously from the horizon *h h'*; and they are most frequently found to dip or decline under that portion of the divided strata which is relatively depressed, as *a* and *b*, not as *x*, which represents a rare and exceptional case. By the sides of faults the strata are often slightly or considerably bent, sometimes in the direction tending to unite their disrupted parts, as *a*; sometimes in the contrary way, as *b*. In the former case they are said to 'rise to an upthrow, and dip to a downthrow;' in the latter they 'rise to a downthrow, and dip to an upthrow.' If these circumstances were carefully recorded by surveyors of collieries, science might eventually combine the detached facts into general laws, shew their dependence on other conditions, and thus put an instrument of discovery into the hands of practical men.

It is a common thing to find valuable coal-beds at first injured, and ultimately rendered worthless, by the interposition of a wedge or band of rock, *r*, in some part of the thickness of the coal; thus the

Fig. 9.

High Main Coal of Newcastle is split, and in a particular direction ruined by the 'Heworth Band.' The upper part of the Great Staffordshire coal-beds goes off in 'the Flying Reed;' and the ten-feet bed of Barnsley in Yorkshire divides into almost unknown parts. If the details of colliery working were more completely recorded, the law of these phenomena could be more accurately traced, so as to answer the anxious questions which such intrusive bands suggest to coal proprietors.

The variations of quality in coal, whether of different beds in the same district (a common case), or of the same beds in different districts (as in South Wales, where good furnace coal is found in the east, and anthracitic coal abounds in the west), are not now known in a scientific form; and therefore science can give no help to practice. Nothing but the union of the parties interested in coal-working can furnish the data necessary for the establishment of general rules. [COAL-FORMATION.]

The beneficial results which mining operations have derived from geology are in proportion to the degree in which the experience of miners has been reduced to the form of science. On the subject of the situation of metallic treasures, already enough is known to show that the occurrence of mineral veins is a circumstance depending on conditions which are more or less ascertainable. For example, there is not, and perhaps has never been, in the British Isles, a single mine of any metal worked in any stratum more recent than the magnesian limestone; it is a general truth that rich veins of lead, copper, tin, &c., abound only in and near to districts which have been greatly shaken by subterranean movement; in Derbyshire, Alston Moor, Flintshire, and, in particular tracts, especially Cornwall and Devon, it is very apparent that near the great masses of granitic rocks the veins are most richly filled. The same facts are almost equally true on the continent of Europe, and in other parts of the world, though, occasionally, as in the Pyrenees, Auvergne, &c., the presence of igneous rocks may cause the exhibition of mineral veins in strata more recent than any of those which in England yield metallic ores.

In all cases where new mining ground is to be attempted, rules such as those above noticed are valuable; but even in districts partially known, or long worked, many problems occur which time and combined registration of phenomena observed might easily solve. These geological problems, as to the relation between the contents of a vein and the nature of the neighbouring rock, the occurrence of certain cross-veins, the depth of the workings, &c., usually present themselves to the practical miner under the general question of the probability of the vein being productive, and though the mining experience of 2000 years has been found insufficient to answer it, there appears no reason to doubt that it is capable of solution by the progress of geology. It is known that in a country of limestone, gritstone, and shale, equally broken by the same fissures, the former is generally most productive of lead (Alston Moor); that certain porphyritic rocks in Cornwall and Saxony appear directly influential on the deposits of particular metals; that argentiferous lead ore is more frequent in primary than in secondary strata; salts of lead more plentiful in the upper parts of veins (Lead Hills, Caldbeck Fells); but the precise nature of the connection of the phenomena is yet a desideratum, and it will be long ere the dim and wavering light of experience can be replaced by the steady beams of the torch of science. In the recent discoveries of gold in California and Australia we have an instance in which geological knowledge pointed successfully to these districts as being likely to contain the precious metal. [MINERAL VEINS.]

In planning the lines of railways, canals, or common roads, the engineer will often be benefited by the records of geological surveys. In looking at the geological map of England, for example, it must be evident to any one acquainted with the geographical characters of the different formations, that no canal can be made from London to the western or north-western counties without a tunnel or summit level on the chalk hills (as at the Kennet and Avon, between Wilton and Devizes, and on the Grand Junction, at Tring). The oolitic range of hills, with its basis of lias, presents a similar and parallel obstacle, conquered by tunnels on the Thames and Severn at Shepperton, the Oxford Canal at Claydon, the Grand Junction at Braunston and Blisworth.

Since then these and other ranges of hills compel the formation of summit levels and tunnels, it is of importance that the whole of a country should be known to the engineer, as to its mineral structure as well as its elevation, in order that the situation of these may be properly fixed. It was inconvenient to make the Thames and Severn tunnel at its present level, often much above the level of the spring which is called the source of the Thames, and in the thirsty oolitic rocks; for thus the cost of maintaining the supply of water by puddling the canal, and engines for pumping, has been found very oppressive. Tunnels and summit levels for canals should certainly be made in argillaceous rocks, and geological investigations will often point out situations where, from particular displacements of the rocks, this is practicable, even in a range of hills so continuous and so calcareous as the chalk or the oolites.

The same rules do not apply to railroads, which, on the contrary, may often be beneficially carried through dry rocky hills which would absorb all the water of a canal.

In the execution of the works of canals and railroads, a good geological map would often be found more serviceable as a guide to the engineer than a great number of borings, unless these were placed in situations corresponding to the variations of the strata, which such a map would indicate.

In some favoured countries the labours of the sculptor and the architect are scarcely injured by exposure to the atmosphere for 2000 years; while in our damp and changeable climate even the interiors of cathedrals show, by the decay of their marbles and the destruction of the stone walls, the necessity for an architect to study the durability of his materials. It is remarkable that the Romans were more prudent or more fortunate in their choice of stone for buildings in Bath and York than their successors have been. The relics in the Institution at Bath abundantly prove that the rag beds of the oolite are more durable than the finer and handsomer freestone which the enterprise of Allen first introduced to common use. The magnesian limestone in the Roman walls of York is in far better condition of preservation than most of that which is of only half the age in the face of the cathedral.

The Saxons in the north of England used the coarse and durable millstone-grit, which on the brows of the high mountains of Derbyshire and Yorkshire stands conspicuous for its bold defiance to the elements. In choosing from any given rock the parts which are most fitted for permanent edifices, the examination of nature is perhaps more instructive than even a study of buildings. Not every sort of water exists in the deeper parts of the earth, and in fact fills the whole space left by fissures in the rocks, unless where, as in diagram, *fig.* 10, there be a fault which breaks the continuity of the communications along the rocks. At the surface there will be generally one or more springs (*z*) along the line of such fault, F.

In sinking deep pits it is generally found that argillaceous strata are quite dry within; for example, in the diagram above referred to, the well *a*, supposed to be sunk in the London clay, yields no water; but the other strata, alternating with the clays, yield water in greater or less quantity, and of quality corresponding with the nature of the rock. Thus the well *b*, sunk down to the sands, lignites, &c., of the plastic clay, yields some water, not always of good quality; but when the well, as *c*, is made to reach to and penetrate the chalk, a great body of good water commonly rises from that rock. [WATER; ARTESIAN WELL, in ARTS AND SC. DIV.]

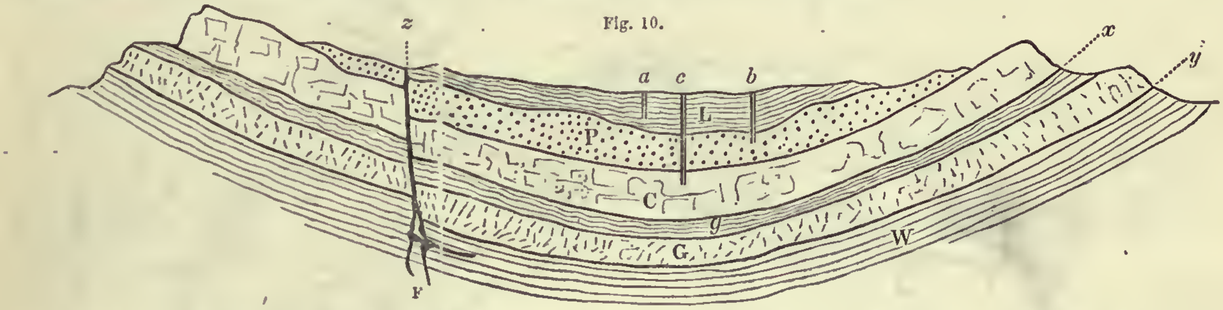
To drain land is to intercept the natural springs: this can never be done upon good principles unless the geological structure of the district be known. When porous rocks alternate with strata impervious to water, the springs will commonly issue at several points on the surface-line of junction of the strata, as at *x* and *y* in diagram, *fig.* 10; and by making a deep drain along the line of junction, Dr. Smith has often accomplished the complete desiccation of wet lands in the oolitic districts of England, which had been in vain guttered in all directions by the usual hollow drains.

The same principle applies, but not with the same ease of success, to the draining of districts where gravel and clay are much intermingled. The gravel acts as a porous rock, but its irregular distribution renders the operation of deep draining costly and less effectual.

From the same principles it follows that springs may be regulated, and the subterranean reservoirs employed to store up water in the winter, when it is little wanted, for the purpose of supplying the demand in summer. This has actually been done by Dr. W. Smith, who opened, in the sandstone rocks near Scarborough, a subterranean reservoir on the site of a little spring, closed it with a dam, and regulated the discharge for the benefit of the town. [SPRINGS.]

(Lyell, *Principles of Geology*; Lyell, *Elementary Geology*; Ansted, *Geology, Introductory, Descriptive, and Practical*; Ansted, *Elementary Course of Geology*; Phillips, *Guide to Geology*; Jukes, *Popular Physical Geology*; De la Beche, *How to Observe in Geology*; Portlock, *A Rudimentary Treatise on Geology*.)

Fig. 10.



a, *b*, *c*, wells; L, London clay; P, plastic clay and sands; C, chalk; *g*, gault; G, lower greensand; W, wealden; *x*, *y*, *z*, springs; the last at a fault, F.

granite resists the carbonic acid and moisture of the air; but while the rolled blocks from Shap-Fell retain, after thousands of years' exposure on the surface, their surfaces of attrition, the granitic top of Castle Abhol, in Arran, is so rotten that it may be easily beaten to fragments by a hammer. The millstone-grit of Brimham is almost wasted away over a hundred acres, while that of Agra Crags appears to be more capable of withstanding the same agencies; and the Druidical stones of Boroughbridge have stood the storms of 2000 years, with little more injury than a few rain-channels which scarcely reach the ground.

To the agriculturist geology has rendered some services, and probably may in future be appealed to for further aid. Lister's proposal for the construction of a map of soils was only partially executed, after a century, in some of the county reports made to the Board of Agriculture. The principal use, as it appears to us, of such a map (and this is in fact supplied by the maps of strata), is to aid the statistics of agriculture by furnishing a basis for comparing the agricultural practices on similar and dissimilar soils.

But geological science will appear more intimately connected with agricultural improvements if we consider it as the basis of all sound knowledge of springs and the subterranean distribution of water. The rain which falls from the heavens upon all soils and rocks indifferently, runs off the clays, but sinks into the limestones, sandstones, and other rocks, whose open joints act like so many hidden reservoirs. Owing to the complicated intercommunication of the fissures, these reservoirs are slowly filled and slowly emptied; both the supply from rain and the discharge from springs may and generally do go on together; and the jointed rocks may be viewed as equalising the supply and expenditure.

But below the level of the springs thus formed, a great body of

GEOMALACUS (Allman) a genus of Molluscous Animals belonging to the family *Limacidæ*. [LIMACIDÆ.]

GEOMYS. [MURIDÆ.]

GE'OPHILA (from γῆ, the earth, and φιλ, love), a genus of Plants belonging to the natural order *Cinchonaceæ*. It has the limb of the calyx 5-parted, with linear spreading segments; the corolla tubular, with a pilose throat and 5 rather recurved lobes, with 5 anthers inclosed; the stigma bifid; the berry ovoid, angular, crowned by the calyx, 2-celled, 2-seeded.

The species are creeping herbaceous plants with stalked cordate leaves, like those of a violet; the stipules are solitary, undivided; the flowers sub-sessile, umbellate, surrounded by bracts, which are shorter than the flowers.

G. reniformis has the petioles hairy above; reniform obtuse leaves, with the lobes at the base approximate; the bracts linear; the peduncles 4-6-flowered, shorter than the leaves. It is a native of moist shady places in the hotter parts of America, as Havanna, Jamaica, Puerto Rico, Brazil, and the basin of the Orinoco. The root of this plant is emetic, and may be used with advantage as a substitute for ipecacuanha.

G. violacea has cordate reniform leaves, obtuse, glabrous, with the lobes approximate at the base; petioles hairy above; umbels few-flowered, almost sessile between the ultimate pair of leaves; bracts linear-lanceolate. It is a native of Guyana, in woods, and of the Isthmus of Panama. It differs from *G. reniformis* by the petioles being shorter, the umbels hardly pedunculate, the corollas violaceous, and the berries blue.

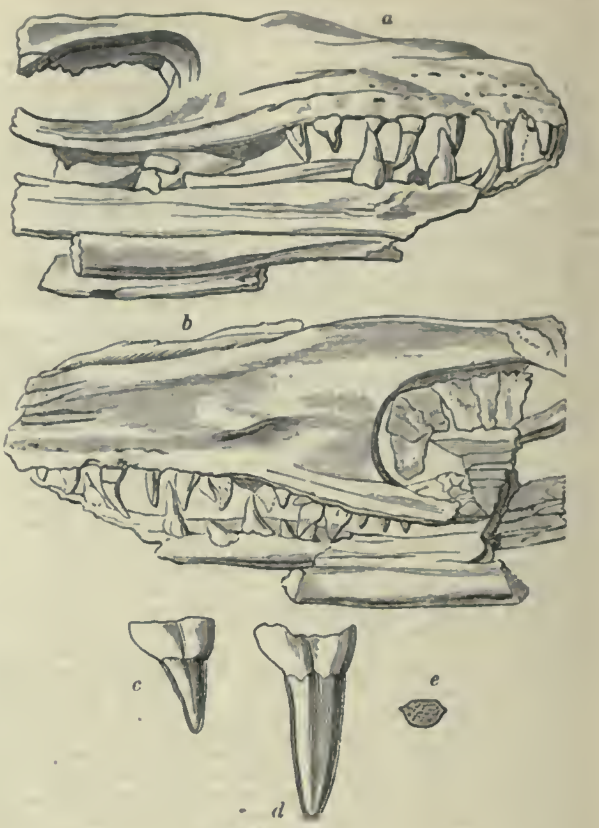
There are several other species of this genus, all of which were formerly referred to the genus *Psychotria*. They are *G. diversifolia*, *G. violæfolia*, *G. macropoda*, and *G. gracilis*.

GEOPHILUS. [COLUMBIDÆ.]

GEORGI'NA, a name sometimes given to the Dahlia, but improperly.

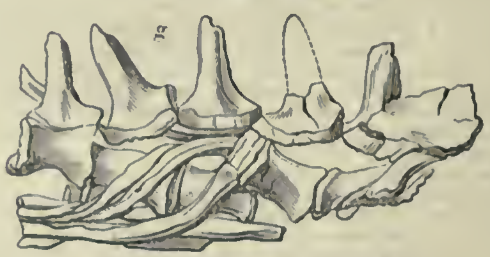
GEO'RYCHUS, Illiger's name for the Lemmings of Cuvier. [MURIDÆ.]

GEOSAURUS, Cuvier's name for a sub-genus of Saurians, found in a fossil state only, and considered by him as intermediate between the Crocodiles and the Monitors. The remains of this animal were first obtained from the white lias at Monheim, in Franconia, by Sömmering, and named by him *Lacerta gigantea*. In a paper in the 'Nova Acta physico-medica Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum,' Dr. Ritgen has proposed a new name for this with several other fossil animals. On this paper a writer in the 'Zoological Journal' has the following remarks:—"The first of Dr. Ritgen's animals is the *Lacerta gigantea* of Sömmering, *Mosasaurus* of Conybeare and Parkinson, for which Dr. Ritgen, without assigning a single reason for the change of name, is pleased to adopt the more than sesquipedalian title of *Halilimnosaurus crocodiloïdes*. This appellation however may serve, in some degree, to explain his views of its affinities and original habitation, inasmuch as it shows that he regards it as a lacertine animal resembling a crocodile and inhabiting salt-water marshes, intermediate therefore between the extinct *Enaliosauri*, or Sea-Lizards, and the living Crocodiles of fresh-water streams. It is, moreover, the *Geosaurus* of Cuvier's 'Ossemens Fossiles.' There is some little obscurity here, which we will endeavour to dispel. That Cuvier's name, *Geosaurus*, should be retained according to the laws of nomenclature, there can be no doubt; and it appears that this provisional name was given, not in reference to the habits of the extinct lizard, but, to use Cuvier's own words ('par allusion à Terre, mère des Géans')—by an allusion to Terra, the Earth—Ge (Γῆ) of the Greeks, the fabled mother of the Giants. Indeed the sclerotic plates still remaining in the portion of the cranium figured by Cuvier in his 'Ossemens Fossiles,' could not have escaped the observation of that acute zoologist (who was so eminently alive to the laws of co-existence), as indicating aquatic habits. That he considered it subgenerically different from *Mosasaurus* appears from the following observations: Immediately after the allusion to the origin of the name, Cuvier says, 'I cannot retain for it the epithet *Giganteus* (Je ne peux lui laisser l'épithète gigantesque); for, in the great genus *Lacerta* we have already the animal of Maestricht, or *Mosasaurus*, which greatly surpassed it, and there is also another (the *Megalosaurus*) which is very superior in size—(nous avons d'abord l'animal de Maestricht, ou *Mosasaurus*, que le surpasse de beaucoup, et nous allons en voir un autre—le *Megalosaurus*—qui lui est aussi très supérieur).'"



Again, in a note to the previous article in the 'Ossemens Fossiles,' on *Mosasaurus*:—"With regard to the fossil animal of Monheim (*Geosaurus*), which M. de Sömmering has also regarded as identical with that of Maestricht (*Mosasaurus*), we shall see in a succeeding article that it differs from the Maestricht animal in many respects. M. Hermann von Meyer, in his most useful work 'Palæologica zur Geschichte der Erde und ihrer Geschöpfe' (8vo. Frankfurt, 1832), widely separates the two sub-genera. The first, *Geosaurus*, he exemplifies by *Geosaurus Sömmeringii*, syn. *Lacerta gigantea*, Sömmering, *Halilimnosaurus crocodiloides* of Ritgen. The second, *Mosasaurus*, Conybeare, *Saurochampsa*, Wagler, he exemplifies by *Mosasaurus Camperi*, syn. *M. Hofmanni*, *Lacerta gigantea*, Sömmering, zum Theil (in part). In his 'System der Fossilen Saurier,' which fossil Saurians he divides into four sections, denoted by the letters A, B, C, and D, he places *Geosaurus* under section A—(Saurier mit Zehen ähnlich denen an den lebenden Sauriern), and *Mosasaurus* under section C—(Saurier mit flossartigen Gliedmassen)."

The remains upon which Cuvier founded his sub-genus were found in the canton Meulenhardt, at the depth of 10 feet, and a few paces from the crocodile described by Cuvier (Gavial of Monheim and of Boll; 'Oss. Foss.' tom. v. pp. 120-125; *Crocodilus priscus* of Sömmering; *Æolodon priscus* of Hermann von Meyer), by the labourers employed to work the mines of granular iron (fer en grains) which fills the fissures of the strata of calcareous schist.



Geosaurus Sömmeringii. (From Cuvier's figures.)

a, *b*, part of the head, which has been compressed; some of the sclerotic plates are still left within the orbit, as seen in Fig. *b*; *c*, *d*, *e*, teeth which had preserved their hard shining brown enamel; *f*, *g*, vertebræ; *f* exhibits a part of the column; near the last vertebræ are the remains of the pelvis and femora; *g*, five vertebræ like the first of those in Fig. *f*. Fragments of ribs in disorder are seen near both sets.

Sömmering, to whom the Count of Reysach gave these precious fragments, to use Cuvier's expression (for in consequence of the nature of the bed in which they were discovered they were not well preserved), published an accurate account of them in the 'Memoirs of Munich' for 1816, accompanied by a lithographic illustration, which Cuvier reduced, and published in his 'Ossemens Fossiles;' Sömmering however thought that the bones belouged to a youug individual of the Maestricht animal (*Mosasaurus*.)

The boues were nearly calcined. Near the remains of the Sauriau were a flat ammonite 4 inches in width, a fragment of bluish shell, and a great quantity of small scales, which, according to Sömmeriug's conjecture, belonged either to fishes or perhaps to the animal itself, if it was a Monitor, or some other lizard witb small scales.

The localities given by Hermanu von Meyer are the Flötz; Solenhofen slate (Schiefer von Solenhofen); and, with reference to another specimen (with a query), for which he refers to Dekay, 'Ann. of the Lyc. of New York,' vol. iii., the marl of the Greeusaud iu New Jersey (Mergel des Grünsandes iu New Jersey).

The original specimens figured and described by Sömmeriug are now in the collection of the British Museum (Wall-case A. B., 'Mantell Fossils of the British Museum,' p. 175).

GERANIACEÆ, *Cranesbills*, a natural order of Exogenous Plants, consisting chiefly of herbaceous plants or shrubs. They have tumid stems separable at the poiuts. The leaves are either opposite or alternate; in the latter case opposite the peduncles, with membranous stipules. The flowers are white, red, yellow, or purple. The sepals 5, persistent, ribbed, more or less unequal, with an imbricated æstivation, sometimes saccate or spurred at the base. The petals 5, seldom 4, in consequence of one being abortive, unguiculate, twisted in æstivation, equal or unequal, either hypogynous or perigynous. The stamens usually mouadelphous, hypogyuous, twice or thrice as many as the petals; some occasionally abortive. The ovary composed of 5 carpels, placed round a long awl-shaped torus or growing poiut, each 1-celled, 2-seeded; styles 5, cohering round the torus, aud separable from it; ovules semianatropal, adhering to the torus. The fruit formed of five shells, coheriug round a long beaked torus, each piece containing one seed, having a membrauous pericarp, and terminated by au indurated style, which finally curls back from the base upwards, carryiug the pericarp along with it. The seeds solitary, without albumen. The embryo curved and doubled up, the radicle pointing to the base of the cell; cotyledons foliaceous, convolute, and plaited. The long beak-like torus round which the carpels are arranged, and the presence of membranous stipules at joints which are usually tumid, are true marks of this order, and all plants not possessing these peculiarities must be excluded. Among them is a South Americau genus called *Rhynchotheca*, which has been even elevated into a natural order, but which, according to Lindley, is surely an oxalid without petals, for the beak observed in its fruit belongs to the carpels and not to the torus. It is clear that in this order the ovules do not spring from the margins of the carpellary leaves. The species, about 500 in number, are very unequally distributed over various parts of the world. A great propotion is found at the Cape of Good Hope, chiefly of the genus *Pelargonium*. *Erodium* and *Geranium* are chiefly natives of Europe, North America, and Northern Asia. *Pelargonium* is found in Australia. An astringent principle and an aromatic or resinous flavour are the characteristics of the order. *Geranium* aud *Erodium* are used in medicinc. *Pelargonium* is remarkable for its beautiful flowers; it is nevertheless astringent in its properties. The affinities of *Geraniaceæ* are with *Balsaminaceæ*, *Oxalidaceæ*, aud *Tropæolaceæ*. (Lindley, *Vegetable Kingdom*.)

Geranium pratense.

1, a magnified calyx, in the centre of which is the rostrum, or beak, from which the cocci are rolling back.

GERA'NIUM, Cranesbill (from γέρανος, crane; the long beak which terminates the capsules resembles the bill of a crane), a genus of Plants the type of the natural order *Geraniaceæ*. The flowers have 5 petals and 5 sepals, 10 monadelphous stamens, alternately larger, and with glands at their base. There are 79 species of this genus enumerated, of which 13 are British; of these ouly two are applied to any useful or medicinal purpose.

G. Robertianum has 2-flowered peduucles; obovate, entire, or slightly emarginate petals; very long glabrous claws; transversely wrinkled downy capsules, smooth seeds, ternate agrimate leaves, and stalked trifid inciso-pinuatifid leaflets. This plaut has small bright crimson flowers, and is found on waste ground, walls, and banks in Great Britain, in Brazil, and Chili. The whole herb has a strong disagreeable smell, which is said to be a preventive against bugs. A decoction of the plant is recommended as likely to give relief in calculous cases. It contaius tannin, and exerts an astringent action on the system, and is given to cattle in some diseases.

G. maculatum, Spotted Crauesbill, has a rather angular stem covered with retrograde pubesceuce; 3-5-parted leaves with deeply-toothed lobes; obovate entire petals; the filaments of the stamens hardly ciliated at the base. This species is a native of North America, from Canada to North Carolina. The flowers are of a pale lilac colour. On account of the astringent nature of this plant, it is known in some parts of North America as Alum-Root, and is employed successfully as a remedy iu dysentery among children, a disease very prevaleut in the parts of the country where it grows. The tincture is recommeuded in cases of ulcerated sore-throat aud soreness of the gums, &c. Dr. Bigelow discovered the presence of large proportions of tanuin and gallic acid in this plant. The quantity of tanniu appears to be greater thau that of any other constituent.

The other British species are :—

G. phæum has 2-flowered peduncles, roundish wedge-shaped petals, rather longer than the mucronate sepals; carpels hairy below, transversely wrinkled above; seeds punctate, striate. It is found in woods aud thickets, rarely.

G. nodosum has obcordate long petioles, awned sepals, even downy carpels; leaves 3- to 5-lobed, lobes ovate, acuminate, serrate. It is fouud iu Cumberlaud aud Hertfordshire.

G. sylvaticum has 2-flowered peduncles, obovate slightly-notched long petals, awned sepals, dotted seeds, palmate 7-lobed leaves. The filaments of the stamens subulate, fruit-stalks erect.

G. pratense has 2-flowered peduncles, the carpels even, hairy, the hairs spreading, glaudular; seeds minutely reticulated; the filaments of the stamens filiform, with a triangular ovate base; the fruit-stalk deflexed.

G. sanguineum has peduncles mostly single-flowered; carpels smooth, crowned with a few bristles; leaves nearly round, 7-lobed; stem diffuse, hairy—the hairs spreading horizontally.

G. pyrenaicum has obcordate petals, twice as long as the mucronate sepals; claws densely ciliated; stem erect, villose.

G. pusillum has bifid petioles, about equalling the mucronate sepals; claws slightly ciliated; carpels with adpressed hairs; seeds smooth; stem diffuse, downy.

G. dissectum has smooth carpels with erect hairs, reticulated seeds; stem diffuse, hairy; leaves divided almost to the base, louger than the peduncles.

G. columbinum has obovate emarginate petioles, ciliated claws; the carpels smooth, with a few minute scattered hairs; the peduncles longer than the leaves; pedicels very long.

G. rotundifolium has spathulate petals, entire, obtuse, rather longer than the shortly-awued sepals; claws glabrous; carpels smooth, with spreading hairs; seeds reticulated.

G. molle has oblong deeply-bifid petioles, ciliated claws; carpels transversely wrinkled, glabrous; seeds smooth; flowers small and purple.

G. lucidum has obovate entire petals; claws glabrous, very long, uearly equalling the transversely rugose pyramidal calyx; carpels reticulated, triply keeled.

G. tuberosum, a plant growing in the south of Europe, particularly in Italy and Silesia, is the γεράνιον of Dioscorides (iii. 121), and the *Geranium tertium* of Pliny (xxvi. 11).

The hardy perennial kiuds of *Geranium* are very beautiful plants, and well adapted for ornamental cultivation. They will thrive iu any common garden soil with ordinary care.

(Don, *Dichlamydeous Plants*; Babington, *Manual of British Botany*; Fraas, *Synopsis Plantarum Floræ Classicæ*.)

GERBILLUS. [MURIDÆ.]

GERFALCON. [FALCONIDÆ.]

GERMEN. [PISTIL.]

GERMINA'TION, the first growth of a seed, the act by which it exchanges the conditiou of an embryo for that of a young plaut. The embryo of a plaut is folded up in the inside of a seed, and is either a short double cone on which two or more cotyledons are fixed, or a simple more or less cylindrical body having no apparent distiuction between the cotyledons and the axis. [SEED.] It has moreover little other than a cellular organisation, very often not possessing a trace of the complicated vascular and tubular structure afterwards developed. The act of unfolding, breaking through the integuments of the seed, and acquiring a vascular and tubular as well as cellular organisation, is germinatiou. When a seed is placed in a moist situation sufficiently warm, and with access to air, the following phenomena, according to the researches of De Saussure, and the more recent ones of Boussingault, take place:—1, absorption of oxygen from the atmosphere; 2, a disengagement of carbonic acid; 3, a disengagement of ammonia; 4, conversion of starch into dextrin, gum, sugar, &c.; 5, increase in bulk—growth of the embryo.

All these phenomena were supposed to be connected with the growth of the embryo, and the absorption of oxygen and the disengagement of carbonic acid gas were regarded as an act of life and as necessary to the process of germination. From this point of view germination and vegetation, the growth of the plant, were stated to be antagonising processes; the one being a respiratory, an oxidating process; the other a decomposing, a deoxidating process. At the same time the albumen of the seed was regarded as the sole source of nutriment for the growing tissues of the young plant. In a paper read at the meeting of the British Association, July, 1845, Dr. Lankester proposed a new theory of the phenomena of germination. It is obvious that the only essential process of germination is the growth of the young plant or embryo. The process of development of the embryo from primitive cytoblasts, is precisely the same as that of every other part of the plant, and from an identity of structure Dr. Lankester inferred there must be an identity of function. But the ordinary theory of germination gives a different function to the tissues of the embryo from that of the other parts of the plant. This Dr. Lankester considers unnecessary, and attributes the absorption of oxygen, and the disengagement of the carbonic acid gas and ammonia, to the result of the decomposition of the starch and protein contained in the perisperm of the seed, whilst the growing cells of the embryo appropriate the carbonic acid and ammonia with water, just in the same way as all other cells in the vegetable kingdom. The facts by which this theory is supported, and which are not explained by the old theory are, as follows:—

1. In many plants there is little or no perisperm or albumen developed, and the conditions required for germination are those of vegetation.

2. Many plants with horny and hardened perisperms, as the *Phytelephas macrocarpa*, the *Phœnix dactylifera*, and species of *Bactris*, *Cocos*, and *Astrocaryum*, germinate, without consuming any appreciable quantity of the perisperm.

3. The quantity of carbonic acid obtained by De Saussure varied not according to the number, but according to the mass of the seeds, proving that it arose from the decomposition of the starch as a chemical process, and not from the growth of the embryo as a process of life.

4. De Saussure found that the relation between the oxygen consumed and the carbonic acid gas given out was different in different plants, but this relation ought to be constant if the theory of oxidation or combustion during germination be correct.

5. Boussingault observed that the changes supposed to be peculiar to germination went on in the perisperm after the young plant had developed its radicle and plumule, and was capable of an independent existence.

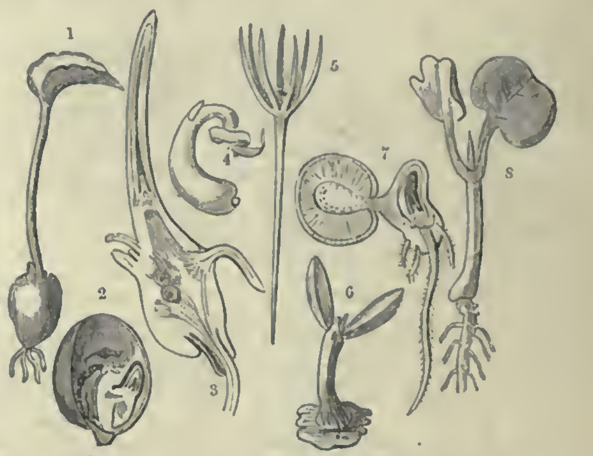
6. The changes which take place in the chemical composition of the perisperm of the seed during germination can be artificially produced by mixing starch and protein (diastase) together, and exposing them to the action of the atmosphere.

This theory modifies the view which is mostly taken of the use of the albumen. It does not appear to be deposited entirely for the use of the young plant, but in many cases is merely an organ of support, and bears the same relation to the embryo that the wood of a branch does to the buds which grow upon it.

The progress of development in the embryo is usually first for the radicle to lengthen, then for the cotyledons to unfold, and then for the plumule to extend into a stem (*fig.* 8); but in Endogens, the plumule of which is often inclosed in the very substance of the cotyledon, a somewhat different process takes place.

In *Potamogeton lucens* (*fig.* 4) the radicle generally swells and lengthens, and at last produces from within its apex a papilla which becomes the root; the cotyledon, which is spiral, at the same time lengthens, and at last the plumule pierces through one side of the embryo. In *Canna Indica* (*fig.* 7) the cotyledon always remains inclosed in the albumen, merely swelling; the radicle and cauliculus are protruded from the seeds; the former turns downwards and emits a number of fine roots, the latter produces from within its substance a conical body, consisting of several sheaths one within the other, which are the rudiments of leaves. The Cocoa-nut differs from *Canna* chiefly in its cotyledon swelling exceedingly and becoming spongy, filling the whole cavity of the seed, and absorbing the milky fluid. Grasses offer only a slight modification of the same form. The embryo of maize, when divided vertically (*fig.* 2) appears like a fleshy plate lying on one side of the flowery albumen; at its back next the albumen is the cotyledon, next the skin is a cone of sheaths (as in *Canna*) forming the plumule, and at the base of the plumule another cone constituting the radicle. When such an embryo germinates, the radicular cone pierces the soil, emitting from its interior, through a kind of sheath, a few slender roots, and protruding others from its surface; and the other cone, representing the plumule, at the same time lengthens upwards in the form of a green spire, leaving the original external part of the sheath at its base (*fig.* 3).

Many anomalies in the development of the embryo of both Exogens and Endogens might be pointed out, but they are of little interest to any but professional botanists. Among the most striking are the following:—In the genus *Pinus* the cotyledons are numerous, and placed in a whorl (*fig.* 5); in the *Cyclamen* the cauliculus enlarges into a roundish turnip-like mass, from the apex of which spring the leaves and flowers, and from the base the roots (*fig.* 1); in mistletoe, a parasitical plant (*fig.* 6), the radicle becomes a flat plate, concave on the under side, by which it adheres to the bark of the plant it grows upon, and from which the singular roots proceed, which eventually insinuate themselves through the bark between the plates of living wood.



The manner in which the radicle protrudes itself is different in Exogens and Endogens. In the former its point gradually lengthens and becomes a new root; this is called 'exorhizal' germination: in the latter the point of the radicle opens and allows the true root to escape from within it, a phenomenon to which the term 'endorhizal' is applied.

Attempts have been made to expedite the process of germination by steeping seeds in a weak solution of chlorine, but no practical advantage has been derived from the experiment. A more effectual plan has been found for hard-shelled seeds, such as those of the *Acacia*, namely, boiling the seeds for a period between one and five minutes. This has certainly, in some cases, had the effect of causing seeds to grow which under ordinary circumstances would not have grown; a circumstance to be ascribed, we conceive, to the hard integuments of the seed being so much softened as to offer no great resistance to the attempts of the embryo to escape from within them, —attempts which required no assistance when the embryo was in full activity and the seed-coat comparatively soft, but indispensable when these conditions are reversed by the loss of vigour in the embryo and the excessive induration of the case containing it.

GERVILLIA, a genus of Molluscous Animals belonging to the *Conchifera*, or Bivalves, hitherto only found in a fossil state. M. Defrance first noticed the genus, which he named after M. de Gerville, who discovered in the Baculite Limestone of Normandy the species on which the genus was established. M. Deslonchamps ('Mémoires de la Société Linéenne de Calvados,' 1824) proposed several modifications of the character, so as to allow the genus to embrace four other shells in addition to the first-described species, *Gervillia solenoides*, viz.:—*Gervilliæ pernoides* (*Perna aviculoides*, Sow., 'Min. Con.,' t. 66), *Siliqua*, *monotis* and *costatula*, which are figured and described in the memoir. M. Defrance thought that the bivalve was furnished with a byssus, but M. Deslonchamps conceives that *Gervillia* has no opening for the passage of that appendage. "Should this prove to be the case," writes the reviewer of the memoir ('Zool. Journ.,' vol. i.), "which we are rather inclined to doubt, it will effectually separate the shells of this from those of the other genera of the *Malleaceæ*. Their nearest affinity is with those of *Perna*, from which they may be at once distinguished by possessing an apparently inner additional hinge, formed of several oblique teeth, variously disposed, according to the species." Mr. G. B. Sowerby ('Genera of Recent and Fossil Shells,') who judges the genus to have been marine from its associates, and who states that there is good reason for presuming that it was adherent by a byssus, gives the following:—

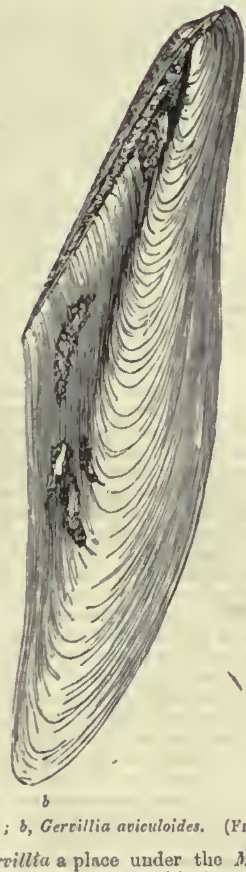
It has the following characters:—Shell oblong, nearly equivalve, very inequilateral, and oblique; hinge-line rather long, linear, nearly straight, with many irregular rather transverse little pits, and teeth placed below the dorsal edge.

Mr. Sowerby regards it as an intermediate genus between *Avicula* and *Perna*. It resembles, he observes, the former in its general form and external appearance; whilst its hinge is somewhat like that of the latter, though sufficiently different to enable us to point out without difficulty the peculiarities by which it may at once be known.

Cuvier, in his last edition of the 'Règne Animal,' places it under Les Pernes (*Perna* of Bruguières), between *Crenatula* and *Inoceramus*.

M. De Blainville arranges the genus under his family *Margaritacea* (the third of his *Acephalophora Lamellibranchiata*), between *Pulvinites* and *Avicula*. He notices that the shell gapes anteriorly, perhaps for the passage of a byssus, and describes the ligament as multiple and inserted in many conical fossæ forming a row within the hinge. He also describes the abdominal impression as single, and as rather anterior.


a


b

a, Gervillia solenoides; b, Gervillia aviculoides. (From Sowerby's Genera.)

M. Rang gives *Gervillia* a place under the *Malleaceæ* of Lamarck, between *Malleus* and *Inoceramus*. In his description he notices the slight anterior opening as being doubtless ('sans doute') for the passage of a byssus.

M. Deshayes, in his edition of Lamarck, notices the memoir of M. Deslonchamps, speaks of the multiple ligament and the single somewhat oval muscular impression placed towards the middle of the length of the shell and on the side of the dorsal edge, and remarks that, like the *Pernæ* and other genera of the family *Malleaceæ*, the *Gervilliæ* are covered externally with a delicate layer of fibrous matter, and that they may be regarded as *Pernæ* with an articulated hinge. The place assigned to them by M. Deshayes is between *Perna* and *Catillus*.

Mr. G. B. Sowerby observes that many species have occurred at various geological periods from the Lias upward to the Baculite Limestone of Normandy. M. De Blainville mentions the species as found in the department of La Manche. The genus occurs in the Cretaceous Group (Greensand), and largely in the Oolitic Group.

GERVI'SIA (Zoology), a name given by Messrs. Quoy and Gaimard to a genus of small Mollusks approximating nearly to *Pleurobranchus*.

GESNERA'CEÆ, *Gesnerworts*, a natural order of Monopetalous Exogens, allied to *Scrophulariaceæ*, and with them forming a portion of the Dicarpous group. They are principally characterised by having an ovary more or less inferior, and a parietal placentation. The leaves are rugose, without stipules, generally opposite or whorled. Flowers in panicles or racemes, seldom solitary. The calyx is half-adherent, 5-parted, with a valvate or open æstivation. The corolla monopetalous, tubular, more or less irregular, 5-lobed, with an imbricated æstivation. Stamens 2 or 4, didynamous; anthers often cohering, 2-celled, innate, with a thick tumid connective; the rudiment of a fifth stamen is present. Ovary half-superior, 1-celled, with 2 fleshy 2-lobed parietal polyspermous placentæ placed right and left of the axis, surrounded at its base by glands or a fleshy ring; style continuous with the ovary; stigma capitate, concave. Fruit capsular or succulent, superior, 2-celled, with 2 opposite lateral placentæ, each consisting of 2 plates. Seeds very numerous, minute; embryo erect in the axis or fleshy albumen, with the cotyledons much shorter than the radicle; testa thin, with very close fine oblique veins, sometimes extended into long hairs, or even flattened into a wing. They inhabit the hot and damp parts of South America, and in some cases overrun trees with their rooting stems in the manner of ivy. The prevailing colour of their flowers is scarlet; some however are purple, as the Gloxinias, and others pale-green, as *Sinningia* and *Drymonia*. Many beautiful kinds are known in our gardens; and several other magnificent species are figured in Von Martius's 'Nova Genera et Species Plantarum,' vol. iii.

Leaves and flowers of *Gesnera grandis*.

1, a corolla laid open to show the interior; 2, a calyx, with the projecting style; 3, a transverse section of a capsule.

GEUM, a genus of Plants belonging to the natural order *Rosaceæ*. It has a flat permanent calyx; a limb in 10 acute deep segments, 5 alternate ones much the smallest. Petals 5, rounded, undivided, or cloven, attached by their claws to the rim of the calyx opposite to its smaller segments, being about equal to the longer ones. The filaments are numerous, awl-shaped from the rim of the calyx, shorter than the corolla. Carpels superior, ovate, compressed, very numerous, in a round head. Styles long, lateral, with a joint above the middle; lower part permanent, upper deciduous. Stigmas simple. Achenia ovate, compressed, hairy, each with a long lateral tail, formed of the enlarged hardened lower part of the style, terminating in a hook. Receptacle cylindrical, dry, hairy, seated on the permanent reflexed calyx.

G. rivale, Water-Avens, is found in meadows and woods throughout Europe, and in Great Britain. It has a root somewhat woody, blackish, creeping, and running deep into the ground; astringent, with the flavour of cloves. The herbage is hairy, and of a deep green. The stem from 8 to 12 inches high, slightly panicled, otherwise simple. The radical leaves are stalked, their terminal lobe very large, rounded, lobed, and sharply crenate. The stem-leaves are few, stalked, ternate, or 3-lobed; stipules of the latter ovate, acute, cut, purplish. The flowers are almost pendulous, singularly elegant, growing upright as the fruit ripens. The calyx of a rich purplish-brown, erect, subsequently reflexed. The petiole is erect, cloven, and of a tawny brown. It is considered to be a stomachic, and is said to be useful in diarrhœa, and is also employed in the United States in diseases of the bladder.

G. urbanum, Wood-Avens, is common in Great Britain and throughout Europe. The root consists of many stout brown fibres, astringent, and in some degree aromatic; it is said to give an agreeable flavour to beer, and even to wine. The stem is 2 feet high, erect, round, rough, and finely hairy; branched at the upper part, bearing several flowers. The radical leaves are on long stalks, interruptedly pinnate, somewhat lyrate; the odd leaflet rounded, often deeply 3-lobed. Stem-leaves ternate, stalked; upper ones simple, 3-lobed, wedge-shaped; all variously notched and serrated, grass-green, veiny, and hairy. The stipules of the stem-leaves very large, round, lobed, serrated, leafy. The flowers terminal, solitary, stalked, commonly small, bright yellow, erect. The calyx spreading, reflexed as the fruit advances. Achenia in an ovate head, numerous, downy, besides a few long coarse hairs about the summit, each tipped with a ripe purplish deflexed awn or tail, which is quite smooth, ending in a sharp small hook.

G. Canadense, Chocolate-Root, Blood-Root, is valued in Prince Edward's Island for its leaves and root, which are used as a mild tonic.

G. intermedium is found in damp woods in England. It has erect or nodding flowers; petals roundish, with a wedge-shaped claw; calyx of the fruit patent; carpophore 0; lower joint of the awn longer than the hairy upper joint; radical leaves interruptedly pinnate and lyrate; stem-leaves 3-lobed; stipules round, toothed; stem from 1 to 2 feet high. The flowers are larger than those of *G. urbanum*, less than *G. rivale*, yellow; calyx purplish. The upper joint of the awn is covered with long hairs, but with rather a long glabrous point.

(Lindley, *Flora Medica;* Babington, *Manual of British Botany*.)

GEYSERS. This name is applied to a series of intermittent hot-springs, situated in the south-western division of Iceland, where nearly one hundred of them are said to break out within a circle of two miles. These springs are evidently connected with the volcanic phenomena which so remarkably characterise the whole district of Iceland. A recent investigator of the eruptive phenomena of Iceland thus describes its more prominent physical features:—

"The surface of Iceland slopes gradually from the coast towards the centre, where the general level is about 2000 feet above the surface of the sea. On this, as a pedestal, are planted the Jökull, or Icy Mountains of the region, which extend both ways in a north-easterly direction. Along this chain the active volcanoes of the island are encountered, and in the same general direction the thermal springs occur, thus suggesting a common origin for them and the volcanoes. From the ridges and chasms which diverge from the mountains mighty masses of steam are observed to issue at intervals, hissing and roaring, and where the escape takes place at the mouth of a cavern, and the resonance of the cave lends its aid, the sound is like that of thunder. Lower down in the more porus strata we have smoking mud pools, where a repulsive blue-black aluminous paste is boiled, rising at times into huge bladders, which on bursting scatter their slimy spray to a height of 15 or 20 feet. From the base of the hills upwards extend the glaciers, and on their shoulders are placed the immense snow-fields which crown the summits. From the arches and fissures of the glaciers vast masses of water issue, falling at times in cascades over walls of ice, and spreading for miles and miles over the country before they find definite outlet. Extensive morasses are thus formed, which lend their comfortless monotony to the dismal scene already before the traveller's eye. Intercepted by the cracks and fissures of the land a portion of these waters is conducted to the hot rocks underneath; here, meeting with the volcanic gases which traverse these underground regions, both travel together, to issue at the first convenient opportunity either as an eruption of steam or as a boiling spring.

"The origin of the water which feeds the springs is here hinted at. That origin is atmospheric. The summits of the Jokull arrest and mix the clouds, and thus cause an extraordinary deposition of snow and rain. This snow and rain constitute the source from which the springs are fed. The nitrogen and ammonia which occur without exception in every spring, exactly as we find them in rain water, furnish the proof of this; for the known deportment of these substances preclude them from being regarded as real volcanic products."

The springs which feed the Geysers, and which are poured out from them again boiling hot, probably take their rise in Mount Hecla, the summit of which is not more than 30 miles from the Geyser district. It is here that the rushing water is sometimes heard in chasms beneath the surface, and it has more than once happened that after earthquakes some of the boiling fountains have increased or diminished in violence and volume, or entirely ceased, or that new ones have made their appearance.

The phenomena of the Geysers of Iceland have for a length of time arrested the attention of naturalists, and many explanations of them have been given. No one has however so successfully investigated the subject as Professor Bunsen, of Giessen. A summary of these views, with experimental illustrations, were presented to the Royal Institution by Professor Tyndall in June 1853. After referring to the general eruptive phenomena of Iceland he described the Great Geyser. "We have here," he says, "a tube 10 feet wide and 70 feet deep; it expands at its summit into a basin, which from north to south measures 52 feet across, and in the perpendicular direction 60 feet. The interior of the tube and basin is coated with a beautiful smooth plaster, so hard as to resist the blows of a hammer. The first question that presents itself is, how was this wonderful tube constructed? How was this perfect plaster laid on? A glance at the constitution of the geyser water will perhaps furnish the first surmise. In 1000 parts of the water the following constituents are found:—

Silica	0·5097
Carbonate of Soda	0·1939
Carbonate of Ammonia	0·0083
Sulphate of Soda	0·1070
Sulphate of Potash	0·0475
Sulphate of Magnesia	0·0042
Chloride of Sodium	0·2521
Sulphide of Sodium	0·0088
Carbonic acid	0·0557

"The lining of the tube is silica, evidently derived from the water; and hence the conjecture may arise that the water deposited the substance against the sides of the tube and basin. But the water deposits no sediment, even when cooled down to the freezing point. It may be bottled up and kept for years as clear as crystal, and without the slightest precipitate. A specimen brought from Iceland and analysed in this institution was found perfectly free from sediment. Further, an attempt to answer the question in this way would imply that we took it for granted that the shaft was made by some foreign agency, and that the spring merely lined it. A painting of the Geyser, the property of Sir Henry Holland—himself an eye-witness of these wonderful phenomena—was exhibited. The painting, from a sketch taken on the spot, might be relied on. We find here that the basin rests on the summit of a mound; this mound is about 40 feet in height, and a glance at it is sufficient to shew that it has been deposited by the geyser. But in building the mound the spring must also have formed the tube which perforates the mound; and thus we learn that the geyser is the architect of its own tube. If we place a quantity of the geyser water in an evaporating basin the following takes place:—In the centre the fluid deposits nothing, but at the edges where it is drawn up the sides of the basin by capillary attraction, and thus subjected to a quick evaporation, we find silica deposited; round the edge we find a ring of silica thus laid on, and not until the evaporation is continued for a considerable time do we find the slightest turbidity in the central portions of the water. This experiment is the microscopic representant, if the term be permitted, of nature's operations in Iceland. Imagine the case of a simple thermal spring whose waters trickle over its side down a gentle incline; the water thus exposed evaporates speedily, and silica is deposited. This deposit gradually elevates the side over which the water passes, until finally the latter has to choose another course; the same takes place here, the ground becomes elevated by the deposit as before, and the spring has to go forward—thus it is compelled to travel round and round, discharging its silica and deepening the shaft in which it dwells, until finally, in the course of centuries, the simple spring has produced that wonderful apparatus which has so long puzzled and astonished both the traveller and the philosopher.

"Before an eruption the water fills both the tube and basin, detonations are heard at intervals, and after the detonation a violent ebullition in the basin is observed; the column of water in the pipe appears to be lifted up, thus forming a conical eminence in the centre of the basin and causing the water to flow over its rim. The detonations are evidently due to the production of steam in the subterranean depths, which, rising into the cooler water of the tube, becomes condensed and produces explosions similar to those produced on a small scale when a flask of water is heated to boiling. Between the interval of two eruptions the temperature of the water in the tube towards the centre and bottom gradually increases. Bunsen succeeded in determining its temperature a few minutes before a great eruption took place; and these observations furnished to his clear intellect the key of the entire enigma. A little below the centre the water was within two degrees of its boiling point, that is, within two degrees of the point at which water boils under a pressure equal to that of an atmosphere, plus the pressure of the superincumbent column of water. The actual temperature at 30 feet above the bottom was 122° centigrade, its boiling point here is 124°. We have just alluded to the detonations and the lifting of the geyser column by the entrance of steam from beneath. These detonations and the accompanying elevation of the column are, as before stated, heard and observed at various intervals before an eruption. During these intervals the temperature of the water is gradually rising. Let us see what must take place when its temperature is near the boiling point. Imagine the section of water at 30 feet above the bottom to be raised six feet by the generation of a mass of vapour below. The liquid spreads out in the basin, overflows its rim, and thus the elevated section has six feet less of water pressure upon it; its boiling point under this diminished pressure is 121°; hence in its new position its actual temperature (122°) is a degree above the boiling point. This excess is at once applied to the generation of steam; the column is lifted higher, and its pressuro further lessened; more steam is developed underneath; and thus, after a few convulsive efforts, the water is ejected with immense velocity, and we have the geyser erpption in all its grandeur. By its contact with the atmosphere the water is cooled, falls back into the basin, sinks into the tube through which it gradually risos again, and finally fills the basin. The detonations are heard at intervals, and ebullitions observed; but not until the temperature of the water in the tube has once more nearly attained its boiling point is the lifting of the column able to produce an eruption.

"In the regularly-formed tube the water nowhere quite attains the boiling point. In the canala which feed the tnbe, the steam which causes the detonation and lifting of tho column must therefore be formed. These canals are in fact nothing more than the irregular continuation of the tube itself. The tube is therefore the sole and snfficient cause of the eruptions. Its sufficiency was experimentally ahown during the lecture. A tube of galvanised iron six feet long was surmounted by a basin; a fire was placed underneath and one near its centre to imitate the lateral heating of the geyser tube. At intervals of five or six minutes throughout the lecture eruptions took place; the water was discharged into the atmosphere, fell back into the basin, filled the tube, became heated again, and was discharged as before.

"Sir George Mackenzie, it is well known, was the first to introduce the idea of a subterranean cavern to account for the phenomena of the Geyser. His hypothesis met with general acceptance, and was even adopted undoubtingly by some of those who accompaued Bunsen to Iceland. It is unnecessary to introduce the solid objections which might be urged against this hypothesis, for the tube being proved sufficient, the hypothetical cavern disappears with the necessity which gave it birth.

"From the central portions of the geyser tube downwards, the water has stored up an amount of heat capable, when liberated, of exerting an immense mechanical force. By an easy calculation it might be shown that the heat thus stored up could generate, under ordinary atmospheric pressure, a column of steam having a section equal to that of the tube and a height of nearly 1300 yards. This enormous force is brought into action by the lifting of the column and the lessening of the pressure described above.

"A moment's reflection will suggest to us that there must be a limit to the operations of the Geyser. When the tube has reached such an altitude that the water in the depths below, owing to the increased pressure, cannot attain its boiling point, the eruptions of necessity cease. The spring however continues to deposit its silica and forms a 'laug,' or cistern. Some of these in Iceland are of a depth of 30 or 40 feet. Their beauty is indescribable; over the surface a light vapour curls, in the depths the water is of the purest azure, and tints with its own hue the fantastic incrustations on the cistern walls; while at the bottom is observed the mouth of the once mighty Geyser. There are in Iceland traces of vast, but now extinct, geyser operations. Mounds are observed whose shafts are filled with rubbish, the water having forced a way underneath and retired to other scenes of action. We have in fact the Geyser in its youth, manhood, old age, and death, here presented to us:—in its youth as a simple thermal spring, in its manhood as the eruptivo spring, in its old age as the tranquil laug, while its death is recorded by the ruined shaft and mound, which testify tho fact of its onco active existence.

"Next to the Great Geyser the Strokkur is the most famous eruptive spring of Iceland. The depth of its tube is 44 feet. It is not however cylindrical like that of the Geyser, but funnel-shaped. At the mouth it is 8 feet in diameter, but it diminishes gradually, until near the centre the diamcter is only 10 inches. By casting stoues and peat into the tube and thus stopping it, eruptions can be forced which in point of height often exceed those of the Great Geyser. Its action was illustrated experimentally in the lecturc, by stopping the galvanised iron tube before alluded to loosely with a cork. After some time the cork was forced up and the pent-up heat converting itself suddenly into steam, the water was ejected to a considerable height—thus demonstrating that in this case the tube aloue is the sufficient cause of the phenomenon." ('Proceedings of Royal Institution.')

The results of the researches of Professor Bunsen on the Geysers of Iceland seem to throw great and unexpected light on the phenomena of volcanoes. Sir Charles Lyell closes his account of Bunsen's researches with the following remarks:—

"In speculating therefore on the mechanism of an ordinary volcanic eruption, we may suppose that large subterranean cavities exist at the depth of some miles below the surface of the earth, in which melted lava accumulates, snd when water containing the usual mixture of air penetrates into these, the steam thus generated may press upon the lava and force it up the duct of a volcano, in the same manner as a column of water is driven up the pipe of a Geyser. In other cases we may suppose a continuous column of liquid lava, mixed with red-hot water (for water may exist in that state, as Professor Bunsen reminds us, under pressure), and this column may have a temperature regularly increasing downwards. A disturbance of equilibrium may first bring on an eruption near the surface, by the expansion and conversion into gas of entangled water and other constituents of what we call lava, so as to occasiou a diminution of pressure. More steam would then be liberated, carrying up with it jets of melted rock, which being hurled up into the air may fall in showers of ashes on the surrounding country, and at length, by the arrival of lava and water more and more heated at the orifice of the duct or the crater of the volcano, expansive power may be acquired sufficient to expel a massive current of lava. After the eruption has ceased a period of tranquillity succeeds, during which fresh accessions of heat are communicated from below, and additional masses of rock fused by degrees, while at the same time atmospheric or sea-water is descending from the surface. At length the conditions required for a new outburst are obtained, and another cycle of similar changes is renewed." ('Principles of Geology,' p. 558.)

GIANT, a man of great or unnatural stature. In the following article we shall mention those deviations from nature which sometimes occur in the proportions of the human form, both as regards the arrest or excess of development, and thus include the description of Dwarfs, or men who are unnaturally small, and beneath the usual size, as well as of Giants, who exceed the ordinary proportions of the human race. In considering this subject we will first allude to the question,—whether the size of man generally was ever different from what it is at the present time. Secondly, we will inquire if it is probable that races or nations of giants or pygmies ever existed. Lastly, we will state the ordinary proportions of the human frame, and enumerate a few examples of men who have much exceeded or have fallen far short of the common standard, and inquire whether these peculiarities of stature can be accounted for in any satisfactory manner.

It is a very common opinion, that in the earlier ages of the world men in general possessed superior physical properties, and were of a greater size than they are at present; and this notion of diminished stature and strength seems to have been just as prevalent in ancient times as at present. Pliny observes of the human height (vii. 16), that "the whole race of mankind is daily becoming smaller;" a most alarming prospect if it had been true. Homer more than once makes a very disparaging comparison between his own degenerate contemporaries and the heroes of the Trojan war. But all the facts and circumstances which can be brought forward on this subject tend to convince us that the human form has not degenerated, and that men of the present age are of the same stature as in the beginning of the world. In the first place, though we read both in sacred and profane history of giants, yet they were at the time when they lived esteemcd as wonders, and far above the ordinary proportions of mankind. All the remains of the human body (as bones, and particularly the teeth), which have been found unchanged in the most ancient urns and burial-places, demonstrate this point clearly. The oldest coffin in the world is that found in the great pyramid of Egypt, and Mr. Greaves observes that this sarcophagus hardly exceeds the size of our ordinary coffins, being scarcely six feet and a half loug. From looking also at the height of mummies which have been brought to this country, we must conclude that the people who inhabited Egypt two or three thousand years ago were not superior in size to the present iuhabitants of that country. Lastly, all the facts which we cau collect from ancient works of art, from armour, as helmcts and breastplates, or from buildings designed for the abode and accommodation of meu, concur in strengthening the proofs against any decay in uature. That man has not degenerated in stature in consequence of the effects of civilisation is clear; because the inhabitants of savage countries, as the natives of America, Africa, Australia, or the South Sea Islands, do not exceed us in size. It has been supposed that before the Delugo men might have been of a larger form than they are at present, as they are said to have lived to a much greater age; but this is a mere assumption, unsupported by any evidence whatever.

When investigating tho subject, whether any peculiar races of meu have ever existod who have greatly varied iu size from tho ordinary proportions of our form, we need not allude to the fabulous stories of the giants and pygmies of antiquity, the former of whom are said to have made war against Jupiter, and the latter to have been not more than a foot high, and to have carried on war against the cranes which used to come and plunder them. Mention is made of giants in several places in Scripture, before the Flood, in the sixth chapter of Genesis, and more plainly after it (Numbers, xiii.); but, as Dr. Derham observes, the ancients vary as to the signification of the Hebrew word 'nephilim' in Genesis. Some translate it by a word signifying 'violent men,' and think that instead of giants in stature, monsters of rapine and wickedness were intended to be represented; and Dr. Johnson says that the idea of a giant is always associated with something fierce, brutal, and wicked. With regard to the giants in Numbers, who are more particularly mentioned, it is probable that the fears of the spies magnified their dimensions. Races of giants are also alluded to by the Greek and Roman historians. The Germans are particularly noticed by Cæsar ('De Bel. Gall.,' lib. i.), and by Tacitus ('De Morib. German.,' c. 4), as being of large size. We have no data for determining their exact stature, but there is no proof that it exceeded that of the tallest of the present German races, many of whom, as the inhabitants of Saxony and the Tyrol, are very large men. The notion of the existence of giants in former times, has in many instances been founded on the discovery of the bones of different large animals belonging to extinct species, which have been ascribed to human subjects of immoderate stature. (See the story in Herodotus, i. 68.) The bones of an elephant have even been figured and described by Buffon as remains of human giants, in the supplement to his classical work (tom. v.). The extravagance of such suppositions has been completely exposed by the accuracy of modern investigation.

Descending to more modern times, the people who have excited the most curiosity and given rise to the most conflicting statements are the Patagonians. The first navigators by whom they were observed represented them as being of colossal stature; but though more recent and accurate accounts describe them as being a very tall race of men, yet the highest does not much exceed 7 feet. Captain Wallis measured several of them carefully, and found that the stature of the greater part was from 5 feet 10 inches to 6 feet. The height of the Patagonians was also measured with great accuracy by the Spanish officers in 1785 and 1786: they found the common height to be from 6½ to 7 feet, and the highest was 7 feet 1¼ inch.

It was once supposed that a nation of white dwarfs existed in the interior of Madagascar, called Quimos or Kimos, with very long arms, but the report is now believed to be perfectly fabulous, and the only fact adduced in support of it was that the Count de Modave, the governor of the French settlement at Fort Dauphin, purchased a female slave of light colour, about 3½ feet high, with long arms reaching to her knees. Blumenbach thinks that this was merely a mal-formed individual. From these and similar observations we may conclude that there is no truth in the existence of giants or dwarfs, except in peculiar individual instances; at any rate, as Dr. Pritchard observes ('History of Mankind'), "every variety of stature which has been found to occur, as the general character of a whole race, is frequently surpassed by individual examples among the inhabitants of the same country."

There is no fixed law by which the human stature can invariably be determined, though there is an average standard from which the deviations either way are not very considerable. The human race varies mostly in height from 4½ feet to a little more than 6 feet, though men are occasionally met with of a much greater stature. Taking away the disposition to deal in the marvellous, we may probably assert that no man ever existed of the height of more than 8 or 9 feet. This may be supposed from what we see at present, and from the deviations which occur in the ordinary course of nature in animals. A skeleton was dug up some years ago on the site of a Roman camp near St. Albans, beside an urn inscribed 'Marcus Antoninus.' Mr. Cheselden, who has described it in the 'Philosophical Transactions' (No. 333), judged that it was 8 feet in height. Goliath, Og (king of Basan), Maximinus the emperor, and others mentioned in sacred and profane history, were also probably very tall men, whose height has been magnified, but who were no bigger than some now occasionally met with. There are many authentic instances of men who have much exceeded the ordinary height, which have occurred in our own times: one of the King of Prussia's gigantic guards, a Swede, measured 8½ feet; and a yeoman of the Duke John Frederick, at Brunswick-Hanover, was of the same height. (Haller, 'Element. Phy.,' lib. xxx. sec. 1. Several Irishmen, measuring from 7 to 8 feet and upwards, have been exhibited in this country; the most celebrated, whose skeleton is in the museum of the College of Surgeons in London, was Charles Byrne, who went by the name of O'Brien: he died at the age of 22, in 1783, and measured 8 feet 4 inches. The skeleton is 8 feet in height. Many examples of dwarfs might also be mentioned. Buffon says that Bebe, the dwarf of Stanislaus, king of Poland, was 23 inches (French) high, and well-proportioned: he died at 23. But of numerous other instances on record most seem to have been ricketty and diseased individuals. Thus, in the skeleton in the museum of the College of Surgeons, of Madlle. Crachami, the Sicilian dwarf, who died at the age of 10 years, and which is only 20 inches in height, the bones appear to have undergone hardly any change after birth. There seems to have been a complete arrest of development, the epiphyses of the bones remaining unossified. One of the most perfect specimens of a dwarf was the individual exhibited in London under the name of General Tom Thumb. He was 28 inches in height, and his head and limbs were remarkably well proportioned. Two dwarfs from South America were exhibited in London in 1853, and called Aztecs. Their heads were small in proportion to their bodies. They exhibited the deficiency of intellect indicated by the small development of their brains.

We may remark that the ordinary size of man is particularly well adapted to his wants and uses; and we generally observe that those individuals who deviate greatly from the common standard, either one way or the other, are neither well-proportioned nor healthy. The head in giants is commonly too small for the rest of the body, and in dwarfs too large.

Both giants and dwarfs have frequently offspring of similar stature to their own, so that a race of men might possibly arise of extraordinary smallness or gigantic size. Of the propagation of giants we have an experimental proof in a fact related by Dr. J. R. Forster ('Observations on a Voyage Round the World'). It is well known that the king of Prussia had a corps of gigantic guards, consisting of the tallest men who could be drawn together from all quarters. A regiment of these huge men was stationed during fifty years at Potsdam. "A great number of the present inhabitants of that place," says Forster, "are of very high stature, which is more especially striking in the numerous gigantic figures of women. This certainly is owing to the connexions and intermarriages of those tall men with the females of that town." Dr. Pritchard is of opinion that peculiarities of stature may in some measure be owing to peculiarities of climate. In his 'History of Mankind' (vol. ii.), he observes, that "there are many nations of very considerable stature in South America. The Patagonians are the most remarkable example, but nearly all the nations of this great country, though distinct from each other in language, manners, and descent, are taller and stouter than the average standard of the human species. . . In Ireland men of uncommon stature are often seen, and even a gigantic form and stature occur there much more frequently than in this island: yet all the British Isles derived their stock of inhabitants from the same sources. We can hardly avoid the conclusion that there must be some peculiarity in Ireland which gives rise to these phenomena." Again: "The tall, lank, gaunt, and otherwise remarkable figures of the Virginians and men of Carolina are strikingly different from those of the short, plump, round-faced farmers in England, who are of the same race." Lawrence ('Lectures on Man') thinks that the source of the deviations from the ordinary stature in man is entirely in the breed, and that they are quite independent of external influences. In endeavouring to account for the diversities of stature which occur we must make an observation which is equally applicable to differences of colour, features, and other particulars, in which individuals and particular races differ from each other, namely, that the law of resemblance between parents and offspring which preserves species, and maintains uniformity in the living part of creation, suffers occasional and rare exceptions; but that under certain circumstances an offspring is produced with new properties different from those of the progenitors.

GIANTS' CAUSEWAY, a remarkable columnar basaltic formation on the northern coast of the county of Antrim, in Ireland, situated about midway between the towns of Ballycastle and Coleraine.

The trap district with which this formation is connected occupies almost the whole of the county of Antrim, and a considerable portion of the eastern part of Londonderry, comprehending an area of about 800 square miles on both sides of the valley of the Bann. The surface rises gradually from the channel of this river till it attains a considerable elevation on each side, when it breaks down in precipitous escarpments, sloping abruptly to the primitive district of Londonderry on the west, and overhanging the coast on the east and north in a series of striking elevations commencing near Belfast, and terminating west of the embouchure of the Bann. Throughout this area the basalt is found capping all the eminences, and constituting the general super-stratum in beds of an average thickness of about 500 feet. Beneath the basalt occurs a series of secondary formations peculiar to this area, which has led to the supposition that they may have been elsewhere removed by some denuding force, "to which, in this quarter alone, an effectual resistance was opposed by the firm and massive super-stratum of basalt which covered and protected them." (Rev. W. Conybeare, in 'Trans. Geological Soc.,' vol. iii. p. 127.)

These formations, which are similar to those underlaid by the coal-measures of the south and east of England, consist, in descending order, of thick beds of indurated chalk, the white limestone of Antrim, succeeded (unless where the series is broken, as it frequently is, by the superior stratum extending beyond the outgoings of the inferior, as at Fair-head, where the basalt rests immediately upon the coal-measures), by mulatto or green sandstone reposing on blue argillaceous limestone, which again rests on the red-sandstone of the coal-formation, which appears to underlie the greater part of the basaltic tract.

The mass of basalt is considerably thicker towards the northern extremity of the area, and it is here chiefly that the series of columnar formations occur. There are three distinct beds of such formations, the uppermost of which is perhaps traceable in the cliffs of the Cave-Hill over Belfast, and is distinctly observable at Fairhead, on the north-eastern extremity of the coast, where the mural precipice of greenstone is articulated into columns of enormous dimensions but rude structure, some of them measuring 250 feet in length by 6 feet on the side. The same formation appears occasionally to recur along the verge of the precipice which trends westward hence to Dunseverick, at a short distance from which the two lower beds emerge from the sea, and, rising along the escarpment of the rock, form colonnades of the most striking appearance for a distance of nearly three miles, when the upper one is lost in the surrounding masses of basalt, while the lower stratum sinks again under water, its denuded extremity forming that particular group of columns known as the Giants' Causeway.

A section of the cliff at Bengore-Head, immediately adjoining the Causeway, gives the following arrangement:—

	Feet.
1. Basalt, rudely columnar	60
2. Red Ochre, or Bole	9
3. Basalt, irregularly prismatic	60
4. Columnar Basalt	7
5. Intermediate, between Bole and Basalt	8
6. Coarsely Columnar Basalt	10
7. Columnar Basalt, the upper range of pillars at Bengore-Head	54
8. Irregular Prismatic Basalt. In this bed the wacke and wood coal of Port Noffer are situated	54
9. Columnar Basalt, the stratum which forms the Causeway by its intersection with the plane of the sea	44
10. Bole, or Red Ochre	22
11, 12, 13. Tabular Basalt, divided by seams of Bole	80
14, 15, 16. Tabular Basalt, occasionally containing Zeolite	80
	488

It is observable that the dimensions of the columns diminish and the perfection of their structure increases as the strata descend. Thus the most perfect arrangement is found in the lowest stratum, of which arrangement the Causeway affords the most perfect specimen. The upper part of the stratum being here denuded for a distance of about 300 yards, exhibits an irregular pavement formed of the tops of polygonal columns, so closely arranged that the blade of a knife can with difficulty be inserted in the interstices. The columns are chiefly hexagonal, but polygons of five, seven, and eight sides are of frequent occurrence; and there is one instance of a triangular prism. These columns are divided into joints of unequal length; each joint is formed by the adjacent extremities being relatively convex and concave, an arrangement which is further secured by the overlapping of the external angles. These convexities and concavities are segments of spheres, the base of each of which occupies a circle inscribed in the polygon of the pillar; the intervals intercepted between the peripheries of these circles and the sides of the polygon are all in the plane perpendicular to the axis of the column. The stone is the most compact and homogeneous variety of basalt, and is more or less sonorous when struck with a hard substance. The entire mass of these columns, of which about thirty feet are exposed above the surrounding shingle at the highest point of their denudation, bears a strong resemblance to an artificial mole projecting from the base of the cliff into the sea.

It is probable that the columnar beds of which the exposed edges present these remarkable appearances along the coast underlie the capping of tabular basalt to a considerable distance inland, as columnar façades break out on the seaward slope of the entire line of elevations extending from Ballycastle to Bushmills, and indications of a columnar tendency have been observed in beds of tabular basalt as far inland as Glen Rovel, near Cushindall, and at the Cave-Hill, near Belfast. Along the coast at Ushethaven, Roanscarave, and Thivigh, are several smaller causeways nearly as perfect as the one described. The columnar strata of the islands of Rathlin and Staffa indicate the extent of the same formation northward and eastward.

The vicinity of the Giants' Causeway affords numerous appearances confirmatory of the opinion that the basalt when superinduced over the secondary strata was in a state of fusion from heat: such are the conversion of old red-sandstone into hornstone, the conversion of clay-slate into flinty-slate, the conversion of coal into cinders, and in numerous instances the conversion of chalk into granular marble, all arising from the contact of trap dykes with the altered strata. At Kenbaan, near Ballintoy, the basalt is found inclosing detached masses of chalk, as well interspersed through trap dykes as in the mass of the formation. Similar instances occur near the Cave-Hill.

Although this is the most important trap district in Ireland, yet basaltic formations are not altogether peculiar to it, columnar façades having been observed in the county of Limerick. [BASALT.]

(*Philosophical Transactions; Transactions of the Geological Society*, vol. iii.; *Guide to the Giants' Causeway*, Dublin.)

GIBBON. [HYLOBATES.]

GIBBSITE, a Mineral consisting of a hydrate of alumina. It occurs in small stalactitic shapes, or mammillary, and incrusting. The colour is grayish or greenish-white. The surface is smooth but nearly dull. Structure sometimes nearly fibrous. Its hardness is 3 to 3·5. Specific gravity 2·3 to 2·4. It occurs in a bed of iron ore at Richmond in the United States of America. This mineral results from the decomposition of felspar, and consists of little else besides water and alumina.

GIESECKITE, a form of *Elæolite* from Greenland. [ELÆOLITE.]

GIGANTHOLITE, a Mineral which occurs crystallised in six- and twelve-sided prisms. Its cleavage is parallel to the six sides of the prism. Colour greenish to dark steel-gray. Lustre between vitreous and waxy. Hardness about 3·5. Specific gravity 2·862 to 2·878. It is found near Temmela in Finland. The following is its analysis by Wachtmeister:—

Silica	46·27
Alumina	25·10
Peroxide of Iron	15·60
Magnesia	3·80
Protoxide of Manganese	0·89
Potash	2·70
Soda	1·20
Fluorine, a trace	
Water with Ammonia	6·00
	——101·56

GILBERTITE, a Mineral occurring in plates lying irregularly together. Its colour is white with a shade of yellow. Hardness 2·75. Lustre silky. Translucent. Specific gravity 2·648. It is found near St. Austell, Cornwall. The following is its analysis by Lehunt:—

Silica	45·155
Alumina	40·110
Lime	4·170
Magnesia	1.900
Protoxide of Iron	2·430
Water	4·250
	——98·015

GILBERTSOCRINUS, a genus of fossil *Echinida*, from the Mountain Limestone. (Phillips.)

GILL-COVERS. [FISH.]

GILLENIA, a genus of Plants belonging to the natural order *Rosaceæ*, and the sub-order *Spireæ*. It has a tubularly campanulate 5-cleft calyx, 5 linear lanceolate petals, 10-20 stamens, very short, inclosed in the tube, 5 carpels almost united into a five-celled capsule, and 2 seeds in each cell. There are only two species of this genus.

G. trifoliata has several stems from the same root, a foot or two in height, alternate trifoliate leaves, the flowers, which are few in number, forming a sort of panicle. The calyx sub-campanulate, or tubular, with the lower half narrowest, the border divided into 5 reflexed acute teeth. Petals 5, the two upper ones separated from the three lower ones, white with a reddish tinge on the edge, lanceolate, unguiculate, contracted, and approximated at the base. The stamens about 20, in a double series within the calyx. Capsules 5, diverging, oblong, acuminate, 2-valved, 1- or 2-seeded. It is a native of North America in shady places, from Florida to Canada. The root is emetic, and possesses properties similar to those of ipecacuanha. It must however be administered in larger doses, and is not so certain in its effects. Some authors attribute a tonic power to this plant when taken in small doses.

G. stipulacea is distinguished by its foliaceous ovate deeply-cut stipules. It grows in humid woods and damp places from Tennessee to Kentucky, in North America. The medicinal properties of this species are the same as those of *G. trifoliata*.

The species of *Gillenia* are elegant and hardy plants, and are therefore worthy of cultivation. They grow best in a peat soil, and may be readily propagated by dividing at the roots early in the spring.

(Don, *Dichlamydeous Plants*; Lindley, *Flora Medica*.)

GILLIESIA'CEÆ, *Gillesiads*, a very singular natural order of Endogens, with the habit of the Scilleous division of *Liliaceæ*, but with extremely remarkable flowers. In the first place there are several bracts at the base of each flower, resembling a calyx, and in reality constituting an involucre; and secondly the calyx is either an urceolate 6-toothed body, or a single lobe resembling a labellum. Of the two known genera, *Gillesia* and *Miersia*, one has six perfect stamens, the other has only three perfect and the remainder sterile and nearly obliterated. They are natives of Chili. ('Botanical Register,' folio 992.)

GILLS. [FISH.]

GILLYFLOWERS, the common name of the Garden Stock, *Matthiola incana*. [MATTHIOLA.]

GILT-HEAD. [CHRYSOPHRYS; CRENILABRUS.]

GINGER. [ZINGIBER.]

GINSENG, a root found in China, to which extraordinary properties have been ascribed: it is not only considered a universal remedy for all maladies, but is spoken of in the highest terms as a specific in particular circumstances. Volumes have been written in Chinese upon the supposed virtues of this root. It is affirmed that it wards off fatigue, invigorates the enfeebled frame, restores the exhausted animal powers, makes old people young, and so on. The weight in gold has been given by the Chinese for this root, which we are told grows only in the most remote and inaccessible parts of Chinese Tartary, where its collection is attended by dangers sufficient to appal the stoutest man. Nevertheless botanists believe the Ginseng to be nothing more than a plant called *Panax quinquefolium*, also found in North America, where no such qualities as those spoken of by the Chinese are recognised.

GIRAFFA (Camelopard of Pennant and authors), a genus of Ruminants, with persistent horns common to both sexes, comprising the tallest of the known quadrupeds. Dr. J. E. Gray makes this genus the type of the tribe *Giraffina*. Horns covered with a hairy skin, with a tuft of hair at the tip. He gives the following synonyms:—

Camelopardina, Gray, 'Ann. Phil.' 1825; 'Cat. Mamm. B. M.' xxvi.
Camelopardalis, Cuv. 'Tab. Elem.' 1798.
Giraffidæ, Gray, 'L. M. Rep.' xv. 307, 1821; H. Smith, Griffith, 'A. K.' v.; J. Brookes, 'Cat. Mus.' 63, 1828.
Derexa, Illiger, 'Prod.' 104, 1811.
Plenicornia, b, Latr. 'Fam. Nat.' 1821.
Camelopardalidæ, Selys Longchamps, 1842.
Elaphiens, part., 'Pomet.' l. c. 184.
Ruminalia stereoceria, part., 'Rafin. Anal. Nat.' 56, 1815.
Ruminantia B. Pygnocerate, part., Bronn, 'Index Palæont.' ii. 709.
Cameli, β, Wagler, 'N. Syst. Amph.' 4—31, 1830.
Cervidæ, part., Ogilby, 'P. Z. S.' 134, 1836.
Cervicornia, §, Sundevall, 'Pecora,' 52.
Unguligrada, part., Sundevall, 'Pecora,' 52.
Ossicornia, Rüppell, 'Verz. Senck. Samml.' 183, 1845.
Camelopardalina, Sundevall, 'Pecora,' 52.
Camelopardineæ, Lesson, 'N. Tab. R. A.' 168, 1842.
Les Girafes, F. Cuvier, 'D. Sci. Nat.' lix. 513.

Giraffa has the following characters:—Lip not grooved, entirely covered with hair, much produced before the nostril; tongue very extensile; neck very long; body short; hinder legs short; false hoof none; tail elongate, with a tuft of thick hair at the end.

G. Camelopardalis, the Giraffe or Camel-Leopard, is the only species. It is the *Cervus Camelopardalis*, Linn.; *C. Capensis*, Geoff., Ogilby; *Camelopardalis Giraffa, a*, Sundevall; *Giraffa Camelopardalis*, Brisson; *Camelopardalis Girafa*, Gmelin.

There is a pale variety, which has the following synonyms:—*Camelopardalis Girafa, β. Æthiopica*, Sundevall; *Camelopardalis Sennaarensis*, Geoff.; *Camelopardalis Æthiopicus*, Ogilby; *Camelopardalis*, Plin.; *Camelo-pardalus*, Jonst.; *Camelus Indicus*, Jonst.; Gyraffe, Belon; *Tragus Giraffa*, Klein; Camelopard, Penn.; Kamel paard, Vosmaer; Giraffe—Thevet, Buffon, Levaill., Shaw, Lichtenst.; Giraffe, or Cameleopard, Harris.

The structure and history of this extraordinary animal have a high interest for the naturalist. We shall first speak of the anatomy of its bones.

The skeleton of a Giraffe arrests the attention of the observer at once:—the head lifted on high upon the extremely elongated neck, the high withers, and the slender length of limb, taken together, contrast strangely with the bony fabrics of the other quadrupeds. A man who looks up at such a skeleton for the first time, and without previous knowledge of its structure, must be struck at finding that the towering neck consists of exactly the same number of bones that form his own. The skull is light and thin. The horns are considered by Dr. Rüppell (who during his travels in Northern Africa obtained in Nubia and Kordofan three specimens, two males and one female) as constituting the principal generic character, they being formed by distinct bones, united to the frontal and parietal bones by a very obvious suture, and exhibiting throughout the same structure as the other bones. In both sexes, he observes, one of these abnormal bones is situated on each branch of the coronal suture, and the male possesses an additional one, placed more anteriorly, and occupying the middle of the frontal suture. The existence of this third appendage is considered to furnish a complete refutation of Camper's theory with regard to the unicorn, namely, that such an occurrence is contrary to nature, and to prove at least the possibility of the existence of such an animal. This appendage is conspicuous in the plate containing the crania ('Atlas zu der Reise im Nördlichen Afrika,' von Eduard Rüppell; pl. 9, fig. *a, a*); and, as it is there represented, rises abruptly from the os frontis with all the appearance of a third horn. Cuvier, in his last edition of the 'Règne Animal' (1829), follows Dr. Rüppell; and, speaking of the horns, says their bony core (noyau osseux) is articulated in youth by a suture on the frontal bone. In the middle of the chanfrein is a tubercle, or a third horn, larger and much shorter, but equally articulated by suture.

The well-known accuracy of Dr. Rüppell demands every degree of respect; and if the figure alluded to be a correct representation of the ordinary state of the adult Nubian male Giraffe, and not an accidental deformity, the third horn would form a good ground for specific distinction. There are skulls of the Cape Giraffe, both male and female, in the museum of the College of Surgeons, and that of the male, which is an adult with the persistent teeth, has no such horn; but there is a considerable gradually-rising protuberance, which is more strongly developed than the same part in the female cranium. In all the crania which we have seen, and in all the living specimens, the females possess this protuberance as well as the males, though not in so high a degree of development; and the true horns, at least the bony cores, are much larger in the male than in the female. It may be said that the living and dead specimens which were at first received from North Africa were comparatively young, though some of them were not so very young. In the giraffes in the Garden of the Zoological Society at the Regent's Park the protuberance will be seen, though that of the female is not quite so highly marked perhaps as those of the males. In a paper read before the Zoological Society of London, Professor Owen has shown that this middle protuberance arising from the head is not a true horn articulated by a suture, but merely a thickening of the os frontis. This position Professor Owen is enabled to lay down from the section of the skull of a male (Northorn) Giraffe, and from the examination of various crania of both Nubian and Cape (male and female) old and young giraffes. There appears to be no evidence to lead to the conclusion that there is anything at any time in this part of the structure naturally that

Skull of the male Giraffe, from Rüppell's figure.

can be considered more than a mere frontal protuberance occasioned by the thickening of the bone—a protuberance which will not separate upon maceration as the two horns will, in the young animal at least. The lightness of the cranium is owing in great measure to the sinuses, which are minutely described by Professor Owen in his paper; these run along the whole upper part of the cranium, and the occiput is raised by their extension. He shows that a principal object of these sinuses is to increase the surface of the attachment of the ligament supporting the head, and draws attention to the remarkable vertical extension of the condyles of the occiput—a structure which enables the animal to tilt its head back, and gracefully and easily to raise it till it is on a line with the neck. The reader will find the section of the head above alluded to in the museum of the Royal College of Surgeons. In the same museum he will find entire crania of the Cape Giraffe (male and female), with other detached bony parts, and a perfect skeleton of the Nubian Giraffe, though it is that of a comparatively young animal. The position and appearance of the elastic cartilages on the posterior edges of the scapulæ are here exhibited, a beautiful provision for the easy springy carriage of the body, which is principally suspended from the muscles there attached, and slung as it were between those points and the sternal and lumbar regions. In the British Museum and the museums of the Geological Society and College of Surgeons, London, are specimens of the skeletons of this animal.

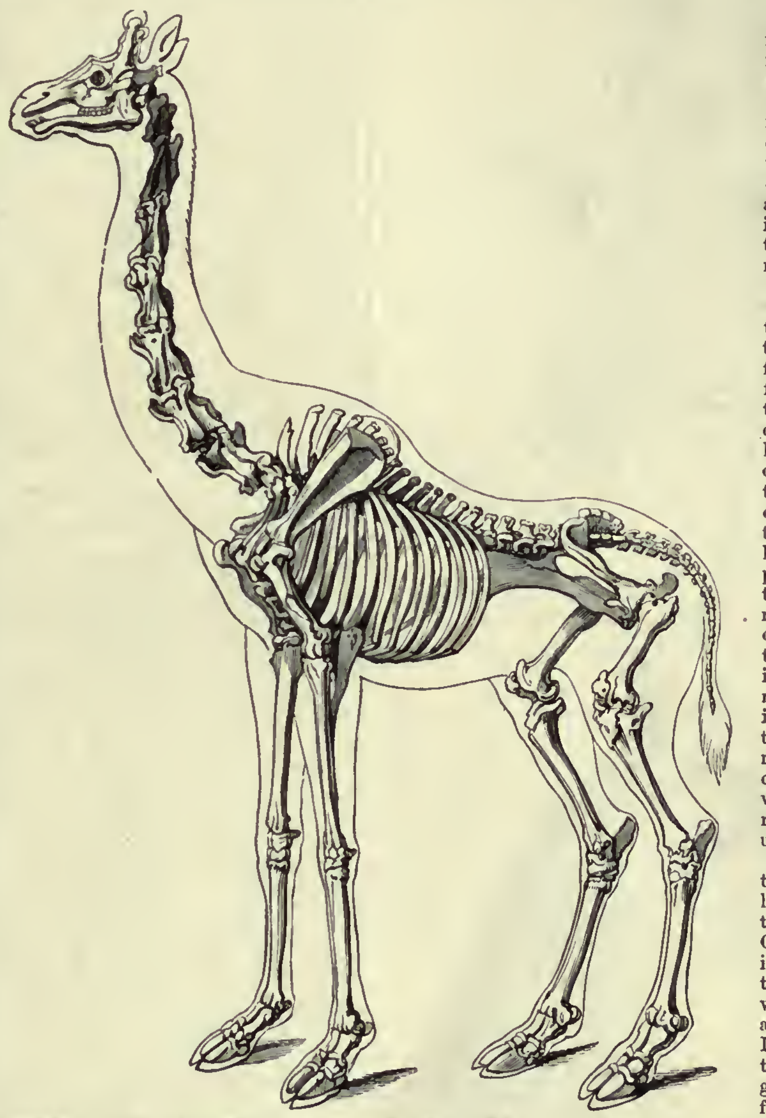
Professor Owen found the ligamentum nuchæ immense, consisting of two bilateral moieties; it commences at the sacrum, gains fresh accessions from each dorsal vetebra, the spines of which are remarkably elongated for that purpose, is inserted into all the cervical vertebræ, with the exception of the atlas, and attached to the extended surfaces of the occipital region of the skull produced by the organisation above alluded to. Before we proceed to notice the softer parts we must refer to the dentition, which offers the same formula as that characteristic of the deer, goat, antelope, sheep, and ox, namely,

$$\text{Incisors, } \frac{0}{8}; \text{ canines, } \frac{0}{0}; \text{ molars, } \frac{6-6}{6-6} = 32.$$

In the 'Nova Acta Physico-medica Academiæ Cæsareæ Leopoldino-Carolinæ Naturæ Curiosorum,' tom. xii., part 1, is a paper by Dr. D'Alton on the teeth of the Giraffe, written, it would seem, principally with a view to correct the notion apparently entertained by Dr. Bojanus in a preceding paper in the same part, not only that the dentition of the *Merycotherium* has certain points indicatory of that animal being intermediate between the camels and the sheep, "camelinum inter et ovillum genus," but that it might possibly be the Giraffe. Dr. D'Alton figures the teeth of the latter, and shows, by a comparison with those of the *Merycotherium*, their discrepancy both in size and structure from those of the fossil animal.

The tongue of the Giraffe requires particular notice. Sir Everard Home remarks, that besides being the organ of taste, it has many properties of the proboscis of the elephant, one being an elongation of the organ of smell, the other of taste. The proboscis is incapable of elongation, he observes, beyond one inch in extent, in consequence of its cartilaginous tubes; while the tongue may be extended to 17 inches after death, and can in the living body lie so diminished in size as to be inclosed within the animal's mouth.

Some mechanism, he remarks, must exist by which this elongation may be performed, as in the tongue of the rein-deer; but he states that a post-mortem examination would be necessary to decide this. He notices the organ as being very smooth; that is, it is smooth when the papillæ are not raised, as they can be at pleasure, but rougher when they are, and slightly adhesive; it is spotted, but the spots are not raised, and there is a black rete mucosum, to prevent, as he thinks, the surface from being blistered by the exposure to the sun. "In the absence of an opportunity," continues Sir Everard, "of examining the internal structure of the Xariffa's tongue after death, I was led to the opinion that the change of size is effected by the organ containing a reservoir, out of the course of the circulation, which can be filled with blood at the will of the animal, so as to give it rigidity, and enable it to extend itself for the performance of the different actions in which it is employed with the smallest possible degree of muscular exertion. It occurred to me at the same time, that whatever construction may be the means by which the Xariffa's tongue is able to apply itself to such various purposes, whether that which appeared to me probable, or any other, something similar would be met with in other animals, particularly in the tongue of the deer, which, after death, readily admits of being drawn out to the extent of 8 inches, although when immersed in rectified spirits it contracts to 5 inches. For the purpose of such an examination, a deer's tongue, recently after the animal's death, was injected with minute red injection, so as to distend the arteries and show the course of the circulation in them to the greatest advantage. This tongue was afterwards divided longitudinally in a perpendicular direction, also in a horizontal one, to show the muscles of which it is composed, as well as the other parts that it contained." From this examination, the structure of the tongue of quadrupeds in general is described by Sir Everard as being longitudinally divided into two equal portions by a middle line; the muscular structure occupies the whole of the interior substance, receiving a large supply of nerves and bloodvessels from a lateral nerve and artery that pass along the outer edge; these are imbedded in a very loose cellular tissue, the texture of which admits of the bloodvessels being distended to a very great degree, so as to enlarge the volume of the tongue; and beyond this tissue, surrounding and forming a case for the whole of the upper and lateral part of the organ, is a strong very elastic covering of some thickness, which yields when the muscles and the trunks of the arteries are distended with blood, so as to give both extent and rigidity to the organ, and admit of the different actions in which it is employed. Sir Everard then adds, that there can be no doubt of the structure of the Xariffa's tongue being the same; its actions depending upon the combined powers of muscular contraction and elasticity; its increase and diminution of size arising from the bloodvessels being at one time loaded with blood and at another empty.



Skeleton of Giraffe; the curved outline from the posterior edge of the scapula shows the position of the elastic cartilage above alluded to.

The chief modification in the muscles of the tongue is in those destined to retract it. Professor Owen, in a note to his edition of 'Hunter's Animal Œconomy' (8vo., London, 1837), says, "A most beautiful and forcible example of the use of tendon in limiting the length of a muscle to the extent of motion required to be produced in the part to be moved, occurs in the sterno-thyroidei of the Giraffe. Had these muscles been continued fleshy as usual from their origin, through the whole length of the neck to their insertion, it is obvious that a great proportion of the muscular fibres would have been useless, because such a condition of the muscle would have been equal to have drawn down the larynx and os hyoides more than one-third of the extent of the neck, which is neither required nor permitted by the mechanical attachments of the parts. The sterno-thyroidei therefore proceed from the head of the sternum blended together in one fleshy fasciculus for about 9 inches, and end in a tendon which is continued for 6 inches; this then divides, and the muscles proceed again fleshy for about 16 inches, when a second tendon intervenes in each between the preceding and the next fleshy portion, which is finally inserted into the thyroid cartilage, and by a continued fascia into the os hyoides: thus the quantity of contractile fibre is proportioned to the required extent of motion by intervening tendons; the sterno-hyoidei being wanting, or their place supplied by the sterno-thyroidei, as in some other ruminants. The analogue of the omo-hyoideus is in the same animal adjusted to its office by a different and more simple modification; its origin is removed from the shoulder-blade to the nearest point (the third cervical vertebra), from which it could act with the requisite force and extent upon the os hyoides."

Sir Everard Home fancied that the Giraffe on which he made his observations, the individual belonging to George IV., preferred licking the hand of a lady to that of a man. Mr. Davis, who saw a great deal of the animal, never observed this. It may be easily believed that the animal distinguished the fair hand from which it received gifts and attention; but certainly the giraffes in the Zoological Garden at the Regent's Park exhibit no such preference. They appear to use their tongues generally as organs of examination, and the power of prehension is so great that we have seen the tongue, when extended to the utmost, grasp an ordinary lump of sugar, of which the animals seem very fond, and convey it into the mouth. We have also observed the giraffes retrovert the tongue for the purpose of cleaning the nostrils, an office which its flexibility enables it to perform in the most perfect manner. The utility of such a power of prehension and extension to an animal whose principal food consists of the leaves and slender twigs of trees is manifest. Mr. Davis says that the tongue can be so tapered as to enter the ring of a very small key.

With regard to the stomach and digestive organs generally, the Giraffe, it is true, wants the receptacle for water which the camel and dromedary possess. There are no water-cells belonging to the rumen as there are in *Camelidæ;* and this part of the structure is, as Professor Owen points out, fashioned according to the horned ruminant type. But he also shows that the reticulum is not, as stated by Sir Everard Home, "destitute of the cellular structure met with in other ruminants," but that it has cells, though very shallow ones, as in the rein-deer. Professor Owen further states that the coils of the colon in the Giraffe are spiral, as they are in the deer and in the antelopes; and that like them it has a simple cæcum, which is 2 feet 2 inches in length. The first giraffe (female) dissected by Professor Owen had a double gall-bladder, each bladder of the usual size: this is preserved in spirit in the museum of the College. The other two giraffes (males) were without a trace of gall-bladder. He believes therefore that absence of the gall-bladder, as in the deer (the antelopes have it), is the rule.

Head of Giraffe (Nubian) with the tongue elongated.

Head of Giraffe (profile), showing the frontal protuberance and the mane. (Nubian.)

The kidneys in the giraffes examined by Professor Owen were not lobulated as in the ox, but simple, as in the deer and antelopes.

Professor Owen found the male organs to agree with the horned ruminant type; that is, the prostate is divided, not single as in the camel. There is a peculiarity in the termination of the urethra; for it is continued as a membranous canal one inch and a half beyond the extremity of the glans, adhering to the prepuce. The female organs differ also from those of the camels, and agree with those of the true ruminants, exhibiting processes for the cotyledons in the interior of the cornua.

These are the principal observations made by Professor Owen in his interesting paper, but he also notices one beautiful provision in the structure of the animal which we must not omit. The nostrils of the Giraffe are provided with cutaneous sphincter muscles, and can be shut at will like the eyes. Professor Owen supposes that the object of this mechanism is to keep out the sand when the storms of the desert arise.

Every one must be struck with the beautiful large eye of the Giraffe; and it will be found upon further examination that it is so placed that the animal can see much of what is passing on all sides, even behind it, without turning the head. Thus it is approached with the greatest difficulty; and if surprised, or run down, it can direct the rapid storm of kicks by which it defends itself in the most accurate manner. We need hardly add that the horny hoofs are divided, and that the two small lateral toes generally seen in the true ruminants are wanting.

We now proceed to speak of the history and arrangement of the Giraffe:—In Deut., xiv., where there is an enumeration of meats, clean and unclean, we find (verse 5), among the beasts which the Israelites are permitted to eat, "the hart, and the roebuck, and the fallow deer, and the wild goat, and the pygarg, and the wild ox, and the chamois." So it stands, or with very slight variation, in the more modern English translations. In the black-letter Bible "imprinted at London by Robert Barker, printer to the king's most excellent majestie (1615)," we find the same verse thus written: "The hart, and the roebucke, and the bugle, and the wilde goate, and the unicorne, and the wild oxe, and the chamois." In the 'Physica Sacra,' the verse is thus given in Latin:—"Cervum, Capream, Ibicem, (*a*) Hircocervum, '(*b*) Unicornem, Urum et *Tarandum*;'" and a note adds, "(*a*) Alii legunt Bubalum aut Bovem Sylvestrem, (*b*) Tragelaphum." Opposite to this stands the following version of the same: "Cervum et Capream, Bubalum, Tragelaphum, Pygargum, Otygem, *Camelopardalum*." These are the Tigurine and Vulgate versions. The original word, it appears, is זמר, Zemer, and Scheuchzer observes that Hieronymus, many interpreters, and many versions render the word by *Camelopardalis*, which is the Zurapha, Zerafet, and Zürafet (plur. Zerafi and Zeraif), of the Arabians; Sürnapa, Zürnapa, Zürnepa, of the Turks; an interpretation which renders the Arabians and Jews doubtful whether the flesh, which is said to be hard and difficult of digestion, be permitted by the law. Bochart rejects the term *Camelopardalis*, because that animal is not an inhabitant of either Arabia or Palestine, but of Nubia and Ethiopia, and therefore was long unknown to Europeans. Scheuchzer adds that Aristotle says nothing about the Camelopard or Cameleopard—"de eâ nil prorsus habet Aristoteles"—and that the first of the Greeks who described it was Agatharchides, who lived in the time of the sixth Ptolemy (Philometor). This animal, he continues, was not seen at Rome before the time of Cæsar: "Unde inferre licet, non ignotam fuisse duntaxat Mosis tempore, sed et Alexandri, qui Mose posterior est annis 1200." Wherefore the commentator has recourse to the Cervine or Caprine genus, and selects the *Rupicapra* (Chamois), observing that 'our two versions' read *Tarandum* (the rein-deer, which, he says, in Meninzk. Lex. has the cognomen of *Sürnapa* and *Giraffa*). In Scheuchzer's plate (ccxxix.) of the clean and unclean animals (Levit., xi. 2), the Giraffe does not appear, but at pl. cccxli. (Deut., xiv. 5), he figures a *Cameleopardalis* and *Tarandus*—'Cameel-Pardel' and 'Rennthier,' the former with sharp antelope-like horns, and the latter with a spotted skin and somewhat extraordinary antlers. With the exception of the head and horns, that part of the Camelopard which appears—the hind-quarters are hidden by the other figure—is not bad. Both figures appear to be copies from Jonston, who seems to have copied one of his Camelopards from Gesner. Scheuchzer introduces the body and head of a Camelopard with the same antelope-like horns, but rather more curved in the background of pl. xxxii. (Gen. iii. 21). The commentator in the 'Pictorial Bible,' where a good cut of the Giraffe is given, says, with reference to the word 'chamois,' "The Arabic version understood that the Giraffe was meant here, which is very likely to have been the case; for the Chamois is not met so far to the southward as Egypt and Palestine. The Giraffe or Cameleopard (*Camelopardalis Giraffa*) is a singular as well as beautiful creature found in the central parts of Africa. The Jews had probably many opportunities of becoming acquainted with the animal while in Egypt, as had also the Seventy, who resided there, and who indicate it in their translation of the Hebrew name."

Belzoni notices the Cameleopard on the walls of the sekos of the Memnonium, and on the back of the temple of Erments. In Gau's 'Nubien' (pl. 15) is the representation of a relief, for the general character of which we refer to the work itself, and to the interesting account published in the 'Library of Entertaining Knowledge: British Museum—Egyptian Antiquities,' vol. i. In the procession appears, among other animals, a well-executed figure of a Giraffe led by a man dressed in skins. The author of the useful and amusing book last quoted supposes the relief to represent the booty obtained after a victory.

Rosellini, in his great work on Egypt, gives the coloured engraving of a Pompa, wherein a Giraffe ('M.C.,' No. xxii., fig. 2), the spots on which are very close, is depicted as led by two men, who hold cords tied to the fore legs below what is called, in common parlance, the knee. A green monkey with a red face, &c., and a long tail, is climbing up the Giraffe's neck. The subligacula of the leaders, who appear to be Nubians (?), are different; those of the one are spotted like a leopard-skin, and this man has a dark blue close cap on his head; those of the other show a sort of reticulated pattern, and he wears a close cap with a light ground and light blue spots. And here it is worthy of note that we find in the enumeratiou of the rare animals exhibited in the Pompa of Ptolemy Philadelphus at Alexandria, described in so lively a manner by one of the Deipnosophists (Athenæus, lib. v. c. 8, s. 32), one camelopard—καμηλοπάρδαλις μία.

Whether the ἱππάρδιος (Hippardius—Horse-Pard) of Aristotle (lib. ii., c. 1) be the Giraffe appears to be doubtful, and the prevailing opinion seems to be that he meant by the word some species of Deer. The passage which mentions the ἱππέλαφος (Hippelaphus—Horse-Stag or Horse-Deer)* states that both these animals have cloven feet and the head armed with horns, but that the female of the Hippelaphus has no horns; thereby intimating that the female of the Hippardius had. This however would be equally applicable to the rein-deer.

The celebrated Prænestine pavement, said to have been made by the direction of Sylla, who had held the office of quæstor in Numidia, represents the Giraffe both grazing and browzing, and it seems to be a good opinion that the artists employed to work in mosaic even in Italy and Spain were Egyptian Greeks. Still the animal itself does not appear to have been seen in Italy before the time of Julius Cæsar, who exhibited it among other animals in the Circensian games.†

In his description Pliny appears to have taken the darker parts of the skin of the animal as forming the ground colour, and relieved by the lighter tint. This is probably the same animal as that mentioned by Varro, who alludes to a *Camelopardalis*, as having been lately brought from Alexandria, in figure like a camel and spotted like a panther. The Giraffe afterwards became a not unfrequent and conspicuous part of the Roman shows. Thus the third Gordian had ten at one time. We trace the animal in the writings of Artemidorus, Strabo, Oppian, Heliodorus, and others, till the great blank of literature intervenes.

After the revival of letters, we find in Belon a good description upon tho whole, and a very tolerable figure. In the small 4to. entitled 'Portraits d'Oyseaux, Animaux, Serpens, Arbres, Hommes et Femmes d'Arabie et Egypte, observez par P. Belon du Mans, le tout enrichy de Quatrains, pour plus facile cognoissance des Oyseaux, et autres Portraits' (1557), the figure is given with only the following notice and quatrain above and below it:—'Portrait de la Giraffe, nommée en Latin Camelopardalis: les Arabes l'appellent Zurnapa.' The quatrain is—

> "Belles de corps les Giraffes, et douices,
> Ont en maintien du Chemeau la maniere.
> Leurs pieds sont haults devant et bas derriere;
> Poil blanc et roux; cornes courtes et mousses."

Gillius states that he saw three at Cairo, and gives a description of the animal. Prosper Alpinus relates that he saw a *Camelopardalis*, "quem Arabes Zurnap, et nostri Giraffam appellant," and likens it to a very elegant small horse.

Gesner, who among other synonyms, enumerates *Giraffa* (alias *Gyrapha*, *Girapha*) as the name of the *Camelopardalis*, or *Camelopardus*, or *Camelus Indica*, gives also *Zirafa*, as well as *Nabis* (Æthiopian), *Girnaffa* (Persian), and *Serapha* (Arabian). His figure, which he says is taken from an Italian printed book, by an anonymous author, is evidently made up principally from the descriptions of the ancients. It has antelope-like subrecurved sharp horns, and a short sharp-pointed tail with something of an upward curve, in which may be traced the 'caudam Dorcalidis, id est Capreoli,' as the text has it, attributed to the animal by Oppian. In the 'Additiones' (Icones, &c.) is presented a much better figure, as far as the horns are concerned, but with a neck, and of a height, generally out of all proportion. The drawing is said to have been diligently taken at Constantinople, where the animal had been sent as a present to the emperor of the Turks, and transmitted to a friend in Germany, A.D. 1559. The figure is without spots.

Aldrovandus gives a figure of the animal with its elongated tongue protruded and browzing upon a tree, which, awkward though it be, would be not very far wrong, were it not for the flowing mane and little sharp horns with a curve forwards.

Jonston gives no less than five figures, three with and two without spots, some with and some without manes, under the names of *Camelopardus*, *Camelopardalis*, *Gierafra*, and *Cameli Indici*, but all with sharp horns of various degrees of curvature, besides two long-necked hornless spotted quadrupeds, one designated as *Camelus Indicus versicolor*, the other as *alius Camelus*.

It is not to be wondered at that some of the figures and descriptions given by such writers as the author last quoted cast a doubt upon the very existence of the animal, and it may not be uninteresting, before we proceed to the later writers on the natural history of this extraordinary animal, to note some of the other evidences preserved in old or uncommon books. In the 'Historia del Grand Tamerlane' (Madrid, 1782), "The ambassadors sent by the king of Castile, Henry III. (1403—2nd embassy), to the great Tamerlane, arrived at a town called Hoy, now Khoy, on the confines of Armenia, where the Persian empire commences. At that town they fell in with an ambassador whom the sultan of Babylon had sent to Tamerlane. He had with him as many as twenty horsemen and fifteen camels, laden with presents which the sultan sent to Tamerlane. Besides these there were six ostriches, and an animal called Jornufa (Giraffe), which animal was formed in the following manner:—In body it was of the size of a horse, with the neck very long, and the fore legs much taller than the hinder ones; the hoof was cloven like that of the ox. From the hoof of the fore leg to the top of tho shoulder it was sixteen hands (palmos); and from the shoulders to the head sixteen hands more; and when it raised its neck it lifted its head so high as to be a wonder to all. The neck was thin like that of the stag; and so great was the disproportion of the length of the hinder legs to that of the fore legs, that one who was not acquainted with it would think that it was sitting, although it was standing. It had the haunches slanting like the buffalo, and a white belly. The skin was of a golden hue and marked with large round white spots. In the lower part of the face it resembled the deer; on the forehead it had a high and pointed prominence, very large and round eyes, and the ears like those of a horse; near the ears two small round horns, the greater part covered with hair, resembling the horns of deer on their first appearance. Such was the length of the neck, and the animal raised its head so high when he chose, that he could eat with facility from the top of a lofty wall; and from the top of a high tree it could reach to eat the leaves, of which it devoured great quantities. So that altogether it was a marvellous sight to one who had never seen such an animal before." ('Library of Entertaining Knowledge —Menageries.')

In the 'Principal Occurrents in John Leo (Leo Africanus) his Ninth Booke of the Historie of Africa' (Purchas, lib. vi. c. 1, sec. 9), we find among the animals of Ethiopia, "The *Giraffa*, so savage and wild that it is a very rare matter to see any of them; for they hide themselves among the deserts and woods where no other beasts use to come; and so soon as one of them espieth a man it flieth forthwith, though not very swiftly. It is headed like a camell, eared like an oxe, and footed like a *; neither are any taken by hunters but when they are very young." In the index of the same book we find "*Camelopardalis*, a huge wilde beast;" and a reference to page 1183, where we find (Purchas, lib. vii. c. 8, s. 2) in the same paragraph, where mention is made of the Abassine soil (Abassia, from Fernandez), this sentence:—"Hares, goats, harts, boars, elephants, camells, buffals, lions, panthers, tigres, rhinocerotes, and other creatures, are there seene, and one so huge that a man sitting on horsebacke may pass uprighte under his belly; his shape is like a camell, but his nature divers, feeding on leaves which he reacheth from the tops of trees with his necke stretched forth." In the margin is printed, "This seemeth to be the *Camelopardalis*;" and, indeed, the description will do very well for it, with the exception of the horse and his rider passing "upright under his belly."

Again, in the fifth volume, 'The Sixt Booke, chap. i., of Africa, and the Creatures therein,' and s. 2, "Of the beasts, wild and tame," is mentioned "the *Giraffa*, or *Camelopardalis*, a beast not often seene, yet very tame, and of a strange composition, mixed of a libard, hart, buffe, and camell, and by reason of his long legs before, and shorter behinde, not able to graze without difficultie; but with his high head, which he can stretch forth halfe a pike's length in height, feeds on the leaves and boughs of trees.

In a note is added, "P. Bellon, lib. ii. c. 49, doth largely describe him. (See his description in Moresou and Sandys.) Also Master Sanderson saw one at Cairo, and hath described him in his 'Voyage,' which I have printed." (Tom. i. lib. 9.) Upon turning to the passage (lib. ix. c. 16, s. 2) it appears that Sanderson saw the animal at Constantinople. "The admirablest and fairest beast I ever saw was a Jarraff, as tame as a domesticall deere, and of a reddish deere colour, white brested, and cloven-footed; he was of a very great height, his fore legges longer than the hinder, a very long necke, and headed like a camell, except two stumpes of horne on his head. This fairest animall was sent out of Æthiopia to this Great Turke's father for a present. Two Turkes, the keepers of him, would make him kneele, but not before any Christian for any money. An elephant that stood where this faire beast was the keepers would make to stand with all his four legges, his feet close together, upon a round stone, and alike to us to bend his fore legges." †

* Mr. Ogilby says ('Zool. Proc.' 1836) that *Tragelaphus Hippelaphus* (*Antilope picta* of authors), the Nylghau [ANTILOPEÆ] or Neelghae, and not the Saumer Deer of India, is the animal described by Aristotle under the name of Hippelaphus.

† "Nabin (Pliny, lib. viii. c. 18) Æthiopes vocant, collo similem equo, pedibus et cruribus bovi, camelo capite, albis maculis rutilum colorem distinguentibus, unde appellata Camelopardalis, dictatoris Cæsaris Circensibus ludis primum visa Romæ. Ex eo subinde cernitur, aspectu magis quam feritate conspicua: quare etiam ovis feræ nomen invenit."

* Here there is a word wanting in the original.

† c. xvi.

"By the permission of Almightie God,
Sundrie the personall voyages performed by John Sanderson, of London,

In the 'Museum Tradescantianum' (1656), at the end of the second section, "Four-footed beasts, with some hides, hornes, hoofes," we find "divers horns answering to those by authors attributed to the *Ibex*, *Gazella*, *Hippelaphus*, *Tragelaphus*, *Cervus palmatus*, *Camelopardalis*, &c."

In Ludolf's '*Æthiopia*,' of which there is a curious translation, 'made English by J. P., Gent' (1682), the following paragraph appears in the chapter 'of four-footed beasts':—"The next is the *Camelopardalis*, or Panther-Camel, which is not" (as big) "and hulkie as the elephant, but far exceeds him in tallness. For this beast is so very high that a man of a just statue (stature) reaches but up to his knees, so that it seems very credible what is reported, that a man on horseback, sitting upright on his saddle, may ride under his belly. He derives his name from hence, that he has a long head and a long neck like a camel, but a skin spotted all over like a panther. The Romans, when they first beheld this beast, called it a wild sheep, tho' being more remarkable for its aspect then (than) its wildness or fierceness, as we read in Pliny. By the Abissines, by reason of the smallness of his tayl, he is called Jerata-Kaein, that is, Slender Tayl; by the Italians Giraffa, from the Arabian word Zucaffa (Zuraffa?)."

Hasselquist, who travelled in the years 1749-50-51-52, mentions, in his 'Voyages and Travels,' the *Cervus Camelopardalis*. The Camel-Deer, Belon.; *Camelopardalis Giraffa*, Alpin., Egypt, Zurnap, Arab. "The colour of the whole body, head, and legs of this animal is variegated," says the traveller, "with dark brown spots; the spots are as large as the palm of a man's hand, of an irregular figure, and in the living animal are of various shades. This deer is of the bigness of a small camel; the whole length from the upper lip to the tail is 24 spans. It is met with in the shady and thick woods of Senaar and Æthiopia. N.B. This is a most elegant and docile animal; it has been seen by very few natural historians, and indeed scarcely by any except Bellonius; but none have given a perfect description or good figure of it. I have only seen the skin of the animal, and have not yet had an opportunity of beholding it alive." In the 'Act. Upsal.' the same zoologist gives a very minute description of the animal.

Brisson gave it a generic station, under the name of *Giraffa*, in the first section of his fifth order, consisting of those quadrupeds which have no incisor teeth in the upper jaw, but eight in the lower, and the hoof divided. This first section contains those genera which have simple horns; and, besides the Giraffe, comprises the goats, the sheep, and the oxen.

Our countryman, John Ray, places the Giraffe under his *Cervinum* genus, the fourth of his ruminants, with the deer, as the title implies.

Linnæus, in the last edition of his 'Systema Naturæ' (1766), gives the Giraffe as the first species of his genus *Cervus*, or *Cervus Camelopardalis*, and describes it as being a *Cervus* with very simple horns, and the fore legs or feet longest. "*C.* cornibus simplicissimis, pedibus anticis longissimis." The habitat he gives as Ethiopia and Senaar, and adds, that the animal even then was obscure, and that it is sprinkled with white spots like fawns: "Animal etiamnunc obscurum, adspersum maculis albis, ut cervi juniores." He alludes to its grazing with divaricated legs, but says that its principal food consists of the leaves of trees.

A drawing, which appears to have been a mere rude sketch, nothing worth, together with a notice of the Giraffe, was brought under the observation of the Académie des Sciences (1764). This drawing and notice related to one of these animals which had been found during a journey made in 1762, as far as two hundred leagues northward of the Cape of Good Hope. Buffon notices this as extending the geographical distribution of the Giraffe, which had been confined to Ethiopia by Thevenot and the majority of writers; but this is the principal contribution to the history of the animal in the count's article, which is indeed learned and eloquent, but erroneous in many points, and unnecessarily severe on Hasselquist for the dryness and imperfection of his description. Buffon gives the description of the Swedish naturalist in a note, and though there may be some obscurity in the part relating to the horns when read by one who had never seen the animal—and of this Buffon particularly complains—that very part shows the accuracy of Hasselquist. For instance, Hasselquist, after describing the hairs round the edge of the top of the horns, says, "Apex cornuum in medio horum pilorum obtusus, nudus" (the apex of the horns in the midst of these hairs is obtuse and naked), thus conveying in a few words the real condition of that part of the structure, and showing the acuteness of his observation. But Buffon had no very great love for Linnæus or his pupils; and Sparrman, in his 'Voyage to the Cape,' attacks the French zoologist in no measured terms, exposing with a rough hand his blunders, and appearing resolved to appease the manes of the meritorious Hasselquist for the insult of the count. Buffon's figure is bad, particularly about the horns, and the mane is too long.

merchant, begun in October, 1584, ended in October, 1602, with an historicall description of Constantinople." The second voyage to Constantinople appears to have commenced in 1591, and Sanderson arrived there on Palm-Sunday, "where," says he, "then I remained sixe or seven yeeres, in which time I had the view of many animals." After enumerating some, he commences the paragraph which we have given in the preceding page.

The description of M. Allamand, in his supplement to Buffon's account, taken from the specimen sent by M. Tulbagh, governor of the Cape of Good Hope, and preserved at Leyden, well supplies the defects of Buffon, and he gives accurate measurements. We would particularly call attention to the following observations of M. Allamand:—"Although the horns are solid like those of a deer, I doubt whether they are shed like them: they seem to be an excrescence of the os frontis, like the bone which serves for the core of the hollow horns of oxen and of goats, and it is scarcely possible that they can be detached. If my doubt is well founded, the Giraffe will be a peculiar genus (un genre particulier) differing from all those under which are comprehended the animals who shed their horns and those whose horns are hollow but permanent." Again, he says, "the adult giraffes have in the middle of their forehead a tubercle which seems to be the commencement of a third horn: this tubercle does not appear upon the head of our specimen, which probably was as yet too young to show it." M. Allamand also remarks that in this young specimen the height of the posterior legs equals that of the anterior, and that the mane is three inches in length.

In 'Phil. Trans.' (vol. lx. p. 27) is the following 'Letter on a Camelopardalis found about the Cape of Good Hope, from Captain Carteret to Matthew Maty, M.D., Sec. R. S.,' dated on board of the Swallow, Deptford, April 20, 1769—read January 25, 1770:—

"Sir,—Inclosed I have sent you the drawing of a *Camelopardalis* (Tab. 1), as it was taken off, from life, of one near the Cape of Good Hope. I shall not attempt here to give you any particular description of this scarce and curious animal, as it is much better known to you than it can be to me; but from its scarcity, as I believe none have been seen in Europe since Julius Cæsar's time (when I think there were two of them at Rome), I imagine its drawing and a more certain knowledge of its reality will not be disagreeable to you. As the existence of this fine animal has been doubted by many, if you think it may afford any pleasure to the curious, you will make what use of it you please.

"The present governor of the Cape of Good Hope has sent out parties of men on inland discoveries, some of which have been absent from eighteen months to two years, in which traverse they have discovered many curiosities, which it is to be hoped they will in convenient time communicate to the world. One of these parties crossed many mountains and plains, in one of which they found two of these creatures, but they only caught the young one, of which the inclosed is the drawing, as it was taken off by them; they endeavoured to bring it alive to the Cape Town, but unfortunately it died. They took off his skin, which they brought as a confirmation of the truth, and it has been sent to Holland. These particulars, as well as the drawing, I got from Mr. Barrawke, first secretary to the Dutch Company at that place, in the presence of the governor. I am, Sir, your most humble, most obedient servant,

"PH. CARTERET."

To this is appended the following note:—

"The animal described in this letter is now in the Cabinet of Natural History at Leyden, where I have seen it this year.

"M. MATY."

Then comes the figure, and opposite to it, p. 29:—

"Dimensions of a male *Camelopardalis*, killed in a journey made in the year 1761, through the country of a tribe of Hottentots called the Mamacquas:—

	Ft.	In.
"Length of the head	1	8
Height of the fore leg, from the lower to the higher part	10	0
From the upper part of the fore leg to the top of the head	7	0
From the upper part of the fore leg to the upper part of the hind leg	5	6
From the upper part of the hind leg to the tail	1	6
Height of the hind leg from the upper to the lower part	8	5"

Pennant, in the first edition (1771) of his 'Synopsis of Quadrupeds,' shows to what extent the doubts of the animal's existence had been carried; for, after adverting to its locality, "the forests of Ethiopia and other interior parts of Africa," and its habits, he proceeds:—"I saw the skin of a young one at Leyden well stuffed and preserved; otherwise I might possibly have entertained doubts in respect to the existence of so extraordinary a quadruped. Belon's figure is very good." The specimen here alluded to was most probably that mentioned by M. Allamand and in Captain Carteret's letter.

The travels of Dr. Sparrman occupied a period from the year 1772 to 1776. He gives Allamand's description, and adds the following:—"This animal, when it goes fast, does not limp, as some have imagined, but sometimes paces and sometimes gallops. Every time it lifts up its fore feet it throws its neck back, which on other occasions it holds erect; notwithstanding this, it is by no means slow when pursued, as M. de Buffon supposes it to be, but, on the contrary, it requires a fleet horse to hunt it. In eating the grass from off the ground it sometimes bends one of its knees, as horses do; and, in plucking leaves and small branches from high trees it brings its fore feet about a foot and a half nearer than usual to the hind feet. A *Camelopardalis* which Major Gordon wounded in the leg, so that it could not raise itself from the ground, nevertheless did not show the least signs of anger or resentment; but, when its throat was cut, spurned against the ground with a force far beyond that of any other animal. The viscera resemble those of gazelles, but this animal had no porus ceriferus. The flesh of the young ones is very good eating, but sometimes has a strong flavour of a certain shrub, which is supposed to be a species of *Mimosa.* The Hottentots are particularly fond of the marrow, and chiefly for the sake of this hunt the beast, and kill it with their poisoned arrows. Of the skin they make vessels, in which they keep water and other liquors."

Le Vaillant did not meet with the Giraffe till his second journey into the interior of Africa from the Cape during the years 1783-84-85. But at the end of the second volume of his first journey, which commenced in 1780, he gives figures of a male and female Giraffe, and a compendium of his observations, remarking that it is a kind of anticipation which is owing in some measure to solicitations which he ought to consider as commands. As Le Vaillant appears to be the first well-informed zoologist of modern times who saw the animal in a state of nature, and as he hunted it and brought it down with his own fusil, his account is worthy of particular attention.

"If," says Le Vaillant, "among the known quadrupeds precedency be allowed to height, the giraffe without doubt must hold the first rank. A male which I have in my collection, and of which a figure is given in the eighth plate, measured, after I killed it, 16 feet 4 inches, from the hoof to the extremity of its horns. I use this expression in order to be understood; for the giraffe has no real horns, but between its ears, at the upper extremity of the head, arise in a perpendicular and parallel direction, two excrescences from the cranium, which without any joint stretch to the height of 8 or 9 inches, terminating in a convex knob, and are surrounded by a row of strong straight hair, which overtops them by several lines. The female is generally lower than the male. That represented in the following plate was only 13 feet 6 inches in height; and her incisive teeth, which were almost all worn away, incontestibly proved that she had attained to her full growth. In consequence of the number of these animals which I killed and had an opportunity of seeing, I may establish as a certain rule that the males are generally 15 or 16 feet in height, and the females from 13 to 14 feet. Whoever should judge of the thickness of these animals from the above dimensions would be greatly deceived. The eye indeed that is accustomed to the long full figures of Europe, finds no proportion between a height of 16 feet and a length of 7 feet, taken from the tail to the breast. Another deformity, if it may be called so, makes us contrast the parts before with those behind. The former have a considerable thickness towards the shoulder, but the latter are so thin and meagre that they do not seem formed the one for the other. Naturalists and travellers who speak of the giraffe all agree in making the hind legs only half the length of those before; but did those who assert so really see the animal, or, if they saw it, did they consider it attentively? An Italian author, who certainly never saw it, caused a figure of it to be engraved at Venice, in a work entitled 'Descrizioni degli Animali,' 1771. This figure is formed exactly from the descriptions which had then been published of the animal; but this exactness renders it so ridiculous, that we must consider it, on the part of the Italian author, as a severe criticism on all the accounts which had appeared, and which have been so often repeated." Le Vaillant then goes on to remark that of all the old authors who have treated of this animal, Gillius is the most accurate, who expressly says that the Giraffe has its four legs of the same length; but that the fore thighs are so long in comparison of those behind that the back of the animal appears inclined like the roof of a house. "If," says Le Vaillant, "by the fore thighs Gillius means omoplate, or shoulder-blade, his assertion is just, and I perfectly agree with him." In a note it is added, that among the moderns the most exact engraving is without doubt that which was executed under the inspection of Dr. Allaman, from drawings furnished by Colonel Gordon. After observing that the account of Heliodorus is far from being correct, Le Vaillant continues thus :— "The horns, forming part of the cranium, as I have already said, can never fall off. They are not solid like those of the stag, nor composed of any substance analogous to those of the ox; much less do they consist of hair united, as Buffon supposes. They are simply of a bony calcareous substance, divided by a multitude of small pores like all bones, and are covered throughout their whole length with short coarse hair, which has no resemblance to the soft down that covers the young horns of roe-bucks or stags." The French traveller then notices the defective figures of Buffon and Vosmaer, observing that the defects disgrace and render of no utility to science such false representations, which people very improperly confide in on account of the reputation of the authors who publish them. He states that the Giraffes, both male and female, are spotted in the same manner; and that, without paying attention to the inequality of size, they may easily be distinguished from each other, even at a distance. The male, on a grayish-white ground, has large spots of a dark-brown colour, almost approaching to black; and the female, on a like ground, has spots of a tawny colour, which renders them less striking. The young males are at first of the colour of their mother, but in proportion as they advance in age and size they become browner.

The Giraffes feed upon the leaves of trees, and particularly on those of a *Mimosa* peculiar to the districts which they inhabit. Meadow-grass also forms part of their aliment; but they are not under the necessity of kneeling down to browze or to drink, as some have improperly believed. They often lie down to ruminate or to sleep, which causes a considerable callosity on the sternum, and makes their knees to be covered with a hard skin. "Had nature," says our author in conclusion, "endowed the giraffe with an irascible disposition, it certainly would have had cause to complain; for the means with which it is provided either for attack or defence are very trifling. It is indeed a peaceful and timid animal; it shuns danger, and flies from it, trotting along very fast: a good horse can with difficulty overtake it. It is said that it has not strength to defend itself; but I know, beyond a doubt, that by its kicking it often tires out, discourages, and even beats off the lion. Except upon one occasion I never saw it make use of its horns: they may be considered of no utility, were it possible to doubt the wisdom and precautions employed by nature, whose motives we are not always able to comprehend."

Gmelin, in his 13th edition of the 'Systema Naturæ' (1789), elevates the Giraffe to a genus under the name of *Camelopardalis*, with the following generic characters :—Horns very simple, covered with skin (simplicissima pelle tecta), terminated by a fasciculus of black hairs. Lower incisor teeth (dentes primores inferiores) eight, spatulate, the last deeply bilobated externally. He gives one species, *Camelopardalis Giraffa*, and says that it inhabits Sennaar, between Upper Egypt and Ethiopia, where it has been now seen: that it is rare in Abyssinia, and most rare in more southern Africa; that its haunts are leafy woods; that it is wild, timid, very swift (celerrima), and elegant; that it reposes prone like a camel; that it feeds on grass by divaricating the fore legs, but that its principal food consists of the leaves of trees.

In the third edition of Pennant (1793), several additions are made to the description of the Giraffe, but he does not notice Le Vaillant, though the first part of the travels of the latter, containing the account which we have already given, was published before the issue of the edition and before it left Pennant's hands; for the preface with his signature is dated 'Downing, December 1792.' He alludes to the measurement in the 'Journal Historique,' and, quoting Paterson, describes the horns as one foot and half an inch long, ending abrupt, and with a tuft of hair issuing from the summit, adding that they are not deciduous.

"The height of that killed by Mr. Paterson," he continues, "was only 15 feet. The head is of an uniform reddish-brown; the neck, back, and sides, outsides of the shoulders and thighs, varied with large tesselated, dull rust-coloured marks of a square form, with white septaria, or narrow divisions; on the sides the marks are less regular; the belly and legs whitish, faintly spotted; the part of the tail next to the body is covered with short smooth hairs, and the trunk is very slender; towards the end the hairs are very long, black, and coarse, and forming a great tuft hanging far beyond the tip of the trunk; the hoofs are cloven, 9 inches broad, and black. This animal wants the spurious hoofs. The female has four teats. Mr. Paterson saw six of these animals together; possibly they might have been the male and female with their four young." Pennant then goes on to say that the animal inhabits the forests of Ethiopia, and other interior parts of Africa, almost as high as Senegal; but is not found in Guinea or any of the western parts, and, he believes, not farther south than about 28° 10′ lat., ('Journal Historique'), among the Nemaques (Namaquas) on the northern side of the Orange River, and that it is very timid but not swift. He says, after alluding to the necessity for the animal to divaricate its legs very widely if it would graze, that it therefore lives by browzing the leaves of trees, especially those of the *Mimosa* and a tree called the wild apricot. "When it would leap," he adds, "it lifts up its fore legs and then its hind, like a horse whose fore legs are tied. It runs very badly and awkwardly, but continues its course very long before it stops. It is very difficult to distinguish this animal at a distance, for when standing they look like a decayed tree, by reason of their form, so are passed by, and by that deception escape." Immediately after this, Pennant repeats verbatim the sentence from the first edition, stating that he had seen the skin of one at Leyden, otherwise he might have entertained doubts, &c. The figure given in this edition is evidently taken from a stuffed specimen, but comes much nearer to the animal than any of those we have hitherto mentioned, except Le Vaillant's. Mr. Paterson who is here mentioned was sent to the Cape as a botanist by Lady Strathmore, and he brought to this country, on his return, the first entire specimen of a Giraffe recorded. Lady Strathmore gave it to John Hunter, in whose museum it long was, and the Trustees of the Museum of the Royal College of Surgeons transferred the skin to the British Museum when that of the college was cleared of the stuffed skins to make way for preparations more in unison with its general zootomical character. This skin, now almost entirely hairless, is still to be seen in the British Museum, where there are also four other specimens and an entire skeleton.

The animal, after this, still continued to be noticed in books of Natural History, but nothing worthy of notice occurs to us, though the reader may be referred to the 'Zoography' of Wood, and especially to Shaw's 'Zoology,' for the information there collected.

Cuvier, in the first edition of his 'Règne Animal,' (1817), speaks of the Giraffe, *Camelopardalis*, as having for its characters conical persistent horns in both sexes, covered with a hairy skin, and as being one of the most remarkable animals on account of the length of its neck, the disproportioned length of the fore legs, the osseous tubercle on the chanfrein, &c., but dismisses it with a very brief notice. He places it between the Deer (*Cervus*) and the Antelopes (*Antilope*).

Major (now Lieutenant-Colonel) Hamilton Smith, who has devoted so much attention to the Cervine and Antelopine groups, observes that the Giraffe stands isolated among the Ruminating animals in family, genus, and even species: its characters, he remarks, offer a mixture of several genera; among which the followers of the quinary system may select whether to class it, with Illiger, among Cameline, or, with other naturalists, amongst Cervine or Antelopine animals. The same zoologist points out its assimilation with the camels by the length of the neck, the callosities on the sternum and knees, and the want of spurious hoofs, an approximation so obvious that it did not escape the notice of the ancients; but, he adds, that the pedunculated form of the frontal process, in the shape of horns, recalls that character in the Muntjak Deer, while the stiff hairs which crown their summits seem to want only the gluten to cement them into true horns and embody it in systematic arrangement with the *Cavicornia*. From a comparison of the characters which Colonel Smith institutes, he thinks that the Giraffe appears most naturally placed immediately after the Muntjaks, and before the family of *Cavicornia*, or those Ruminants which are distinguished by the possession of true horns.

M. Lesson, in his 'Manuel' (1827), places the Camelopardinées between the Cervules (*Cervus Muntjak*, *Cervus moschus* or *moschatus*, and *Cervus subcornutus*) and the Tubicornes (Antelopes, &c.).

Cuvier, in his last edition of the 'Règne Animal' (1829), appears to take the same view of the case as Lieutenant-Colonel Smith, for he there places the Giraffe between the Muntjak and the Ruminants à Cornes Creuses, the first genus of which is *Antilope*. The character assigned to the genus in this edition differs somewhat from that given in the former one, for Cuvier, who seems to have been acquainted with Dr. Rüppell's interesting memoir above alluded to, adds that the bony core (noyau osseux) of the horns is articulated in youth upon the os frontis by a suture, and that in the middle of the chanfrein is a tubercle or third horn, larger and much shorter, but equally articulated by a suture. He still keeps the observation as to the disproportioned height of the fore legs.

Fischer, in his 'Synopsis,' introduces the Giraffe (*Camelopardalis*) between *Cervus* (*Cervus Guineensis*, Linn., *C. minutus*, Blainv.) and *Antilope* (*A. cervicapra*). He notices the opinion of M. Geoffroy, that the Giraffe of Senaar differs in species from that of the Cape, and he alludes to the following names of the animal:—Jiratalla Amhar; Deba of the Æthiopians; Naip of the Hottentots; Impatoo of the Bosjesmans.

Mr. Swainson, 'Classification of Quadrupeds' (1835), appeals to the opinion and views of Colonel Smith, as confirming the station assigned to the *Camelopardæ*, in his tabular exposition of the families of Ruminants, namely:—

Tribe *Ruminantes*. The Ruminating Quadrupeds.

1. Sub-typical.	Horns sheathing; form gracile, slender.	*Antilopidæ.*	Antelopes.
2. Typical.	Horns sheathing; form heavy; robust.	*Bovidæ.*	Oxen.
3. Aberrant Group.	Horns solid, deciduous.	*Cervidæ.*	Stags.
	Horns wanting; fore legs shorter than the hinder.	*Moschidæ.*	Musks.
	Horns very short, covered with a skin.	*Camelopardæ.*	Giraffes.

The following is Mr. Swainson's definition of his family *Camelopardæ*:—"Frontal processes (in both sexes) prolonged in the shape of horns, covered with hairy skin, which is continued from the scalp, and terminated by long hard bristles." "*Camelopardalis*, Ant., cutting teeth, $\frac{0}{8}$; canine none; grinders, $\frac{6}{8}$. Head long; upper lip entire; lachrymary sinus wanting; neck enormously long, with a short mane; the anterior parts much elevated; back sloping; legs slender, the hinder ones shortest; tail tufted. 2. Sp. Africa. 1. *C. antiquorum*, Sw., Northern Giraffe. 2. *C. australis*, Sw., South African Giraffe. The ruminants are united by this genus and *Camelus* to the *Solipedes*." The family is accordingly placed in this part of the work, between the *Moschidæ* and the tribe *Solipedes* (single-hoofed quadrupeds), the first genus of which, in Mr. Swainson's arrangement, is *Camelus*. Mr. Swainson adds, that there seems good reason for believing that a third species of Giraffe exists in the interior of Africa.

In December 1836 Mr. Ogilby divided the *Ruminantia* into the following families:—1, *Camelidæ*; 2, *Cervidæ*; 3, *Moschidæ*; 4, *Capridæ*; 5, *Bovidæ*. The genus *Camelopardalis* is placed by this zoologist, to whom we are indebted for much and valuable information concerning the Ruminants, as the first of the *Cervidæ*, with the following characters:—Horns, in both sexes, persistent (perennia), simple, covered with skin. Rhinaria, none. Lachrymal sinuses, none. Interdigital fossæ, small. Inguinal folliculi, none. Teats, four. Two species are recorded under the names of *C. Æthiopicus* and *C. Capensis*. The other genera admitted by Mr. Ogilby into the family *Cervidæ* are *Tarandus*, *Alces*, *Cervus*, *Capreæ*, and *Prox*.

The main result of Professor Owen's observations (1838) is to agree with Cuvier in placing *Camelopardalis* between *Cervus* and *Antilope*, and he thinks somewhat nearer the deer. He finds that the organs of relation are those chiefly modified in correspondence with the peculiar geographical position and habits of the Giraffe, the organs of nutrition differing but little from those of other horned Ruminants.

Dr. Gray places his tribe *Giraffina* after the *Bovina* and before the *Cervina*, in the order *Ungulata*.

We must now trace the reappearance of the living animal in Europe. M. Lesson states that the first were an offering by the Prince of Damascus to the emperor Frederick II., and described by Albertus Magnus, under the name of Seraph and Anabula. The author of the 'Menageries' remarks that, till the year 1827, when a Giraffe arrived in England and another in France, the animal had not been seen in Europe since the end of the 15th century, when the Soldan of Egypt sent one to Lorenzo de' Medici. This individual was represented in the frescoes at Poggio Acajano, a villa belonging to the grand duke of Tuscany, between Florence and Prato. It was, the author adds, very familiar with the inhabitants in the former city, living on the fruits of the country, particularly apples, and stretching up its long neck to the first-floors of the houses to implore a meal. Of the comparatively late arrivals, another was at Venice in 1828, and a fourth was sent to Constantinople, but died there. These animals, according to the same authority, were all presents from the Pasha of Egypt. The Giraffe sent to the French menagerie did well: that presented at the same time to George IV. was the shortest and weakest. [The consuls of each nation drew lots for the choice.] She was never in good health and had been roughly treated, and though she had grown 18 inches up to June 1829, she sank gradually and died in the autumn of that year.

The Zoological Society of London had entered into a contract for the purchase of Giraffes, and in 1836 four of these animals (three males and one female) were safely brought from the south-west of Kordofan, where they were captured, to the gardens of the society at the Regent's Park. The following account of the capture of these animals is given by the author of 'Zoological Anecdotes:'—

"M. Thibaut quitted Cairo in April 1834, and after sailing up the Nile as far as Wadi Halfa, the second cataract, took camels and proceeded to Debbat, a province of Dongolah, whence he started for the desert of Kordofan.

"Being perfectly acquainted with the locality, and on friendly terms with the Arabs, he attached them still more by the desire of profit. All were desirous of accompanying him in the pursuit of the giraffes, for up to that time they had treated them solely for the sake of their flesh, which they ate, and the skin, of which they made bucklers and saudals. The party proceeded to the south-west of Kordofan, and in August were rewarded by the sight of two beautiful giraffes; a rapid chase of three hours, on horses accustomed to the fatigues of the desert, put them in possession of the largest of these noble animals; unable to take her alive, the Arabs killed her with blows of the sabre, and cutting her to pieces, carried the meat to their head-quarters, which had been established in a wooded situation—an arrangement necessary for their own comfort, and to secure pasturage for their camels. They deferred till the following day the pursuit of the motherless young one, knowing they would have no difficulty in again discovering it. The Arabs quickly covered the live embers with slices of the meat, which M. Thibaut pronounces to be excellent.

"On the following morning the party started at daybreak in search of the young giraffe, of which they had lost sight not far from the camp. The sandy desert is well adapted to afford indications to a hunter, and in a very short time they were on the track of the object of their pursuit; they followed the traces with rapidity and in silence lest the creature should be alarmed whilst yet at a distance; but after a laborious chase of several hours through brambles and thorny trees, they at last succeeded in capturing the coveted prize. It was now necessary to rest for three or four days, in order to render the giraffe sufficiently tame; during which period an Arab constantly held it at the end of a long cord; by degrees it became accustomed to the presence of man, and was induced to take nourishment, but it was found necessary to insert a finger into its mouth to deceive it into the idea that it was with its dam; it then sucked freely. When captured its age was about nineteen months. Five giraffes were taken by the party, but the cold weather of December 1834 killed four of them in the desert on the route to Dongolah; happily that first taken survived, and reached Dongolah in January 1835, after a sojourn of twenty-two days in the desert.

"Unwilling to leave with a solitary specimen, M. Thibaut returned to the desert, where he remained three months, crossing it in all directions, and frequently exposed to great hardships and privations; but he was eventually rewarded by obtaining three giraffes, all smaller than the first. A great trial awaited them, as they had to proceed by water the whole distance from Wadi Halfa to Cairo, and thence to

Alexandria and Malta, besides the voyage to England. They suffered considerably at sea, during a passage of twenty-four days in very tempestuous weather, and on reaching Malta in November they were detained in quarantine twenty-five days more; but despite all these difficulties they reached England in safety, and on the 25th of May were conducted to the gardens. At daybreak the keepers and several gentlemen of scientific distinction arrived at the Brunswick Wharf, and the animals were handed over to them. The distance to the gardens was not less than six miles, and some curiosity, not unmingled with anxiety, was felt as to how this would be accomplished. Each giraffe was led between two keepers by means of long reins attached to the head: the animals walked along at a rapid pace, generally in advance of their conductors, but were perfectly tractable. It being so early in the morning few persons were about, but the astonishment of those who did behold the unlooked-for procession was ludicrous in the extreme. As the giraffes stalked by, followed by M. Thibaut and others in Eastern costume, the worthy policemen and early coffee-sellers stared with astonishment, and a few revellers, whose reeling steps proclaimed their dissipation, evidently doubted whether the strange figures they beheld were real flesh and bone, or fictions conjured up by their potations; their gaze of stupid wonder indicating that of the two they were inclined to the latter opinion.

"When the giraffes entered the park, and first caught sight of the green trees, they became excited and hauled upon the reins, waving the head and neck from side to side, with an occasional caracole and kick-out of the hind legs, but M. Thibaut contrived to coax them along with pieces of sugar, of which they were very fond, and he had the satisfaction of depositing his valuable charges without accident or misadventure in the sanded paddock prepared for their reception. The sum agreed on with M. Thibaut was 250*l.* for the first giraffe he obtained, 200*l.* for the second, 150*l.* for the third, and 100*l.* for the fourth—in all 700*l.*; but the actual cost to the society amounted to no less than 2386*l.* 3*s.* 1*d.*, in consequence of the heavy expenses of freight, conveyance, &c."

One of these animals (a male) died shortly after its arrival. In 1838 the following were the measurements of the three survivors:—

	Height as far as reach.		Wither.		Rump.	
	Feet.	Inches.	Feet.	Inches.	Feet.	Inches.
Guib Allah (male) . .	13	8	7	11	6	11
Selim (male) . . .	13	0	7	5½	6	7
Zaida (female) . . .	12	11	7	4	6	7

When they arrived at the gardens on the 24th of May 1836, Guib Allah could reach only to 11 feet 6 inches, so that he has grown since that time 2 feet 2 inches. The others have grown in proportion. The length of the mane in one of the males and in the female is 2¾ inches, and in the other male 2½ inches.

Since this time the female has produced several young ones, which have been sold, and are still living in various parts of the world. They seem to bear confinement very well, although it should be remembered that their apartments in the Society's gardens are very airy and well ventilated. Two females have since been added to the collection in the gardens.

They are fed principally on the best hay, placed in high racks; they like a carrot, and are very fond of onions; lump-sugar is also a favourite treat to them. They each eat about 18 lbs. of food a day, and drink four gallons of water.

The erroneous statement that the fore legs are longer than the hind legs has been repeated so frequently and so lately by authorities which deservedly have weight, that it becomes necessary to give the result of examination of the skeleton. In reality the hind legs, taking the limbs only from their setting on, are longer than the fore legs by about one inch. A measurement taken from the head of the humerus to the end of the ungueal phalanges in the fore foot, gives an inch less in length than a measurement taken from the head of the femur to the end of the ungueal phalanges in the hind foot.

Neither Mr. Swainson nor Mr. Ogilby gives any specific characters for the two species named by them, and but one species is recognised by Dr. Gray. If, as Professor Owen's observations tend to show, there is no third horn in the forehead of the northern male giraffes, we do not exactly see on what the specific character is to rest. The dark colour of the adult male of Southern Africa, if it should prove to differ from that of the northern male, would not, it is submitted, sanction more than variety. The specimens presented by Mr. Burchell to the British Museum came from Kosi Fountain, and the difference between the dark spots of the male and the tawny spots of the female s strongly marked. The specimen from Central Africa presented by Colonel Denham is very young, and the spots are bright yellowish tawny. Mr. Steedman, in his 'Wanderings and Adventures in the Interior of Southern Africa' (1835), says that the giraffes are found on the open plains several days' journey to the north of Litakou in small troops of six or ten individuals, and that they feed principally upon the various dwarf species of *Acacia** which grow abundantly in the arid deserts. The writer adds that, though formerly found within the boundaries of the Cape of Good Hope, they have not for many years past been known to pass the Gareep, or Orange River, which separates it from the Griqua and Coranna country; and he notices their moving the fore and hind feet of the same side, and then the opposite pair alternately, exhibiting the pace which is usually called an amble in horses.

* Sir Everard Home states that the favourite species is *Acacia Xariffiana*, named from Zariffa, the Giraffe. Le Vaillant says that the sort of *Mimosa* on which it feeds is called 'Kanaap' by the natives, and 'Kameldoorn' by the colonists.

Giraffa (*Camelopardalis Giraffa*).

Those who wish to obtain further information on the Giraffe should consult the works of Klein, Schreber, Vosmaer, Zimmerman, and Lichtenstein; also Sir W. C. Harris's 'Portraits of the Game and Wild Fowl of South Africa,' and Captain Gordon Cuming's 'Adventures.'

GIZZARD, the muscular or pyloric division of the stomach in birds. In these animals the stomach is divided into two parts. The lower œsophagus (the canal which is continued from the crop to the stomach) first dilates into a cavity called the proventriculus, or glandular division of the stomach; this has a very vascular lining membrane, and is furnished with numerous large follicles, or glands, placed between the mucous and muscular coats, which secrete a solvent fluid very similar to the gastric juice in *Mammalia*. This first division of the stomach mostly terminates immediately in the gizzard, which is situated below the liver, on the left side of the abdomen, resting on the intestines. This organ has more or less a lengthened form, and is furnished at its upper part with two openings, the cardiac and pyloric, which are close together; the former communicates with the proventriculus and the latter with the intestines. Below those openings the gizzard dilates into a pouch, in the middle of the anterior and posterior sides of which is a tendon to which muscular fibres are attached. In birds of prey, whose food is easily digested, the gizzard is a mere membranous cavity; but in graminivorous birds it is furnished with muscles of great power, which are arranged in four masses: the two largest, which are situated anteriorly and posteriorly, are connected with the central tendons, and are called the digastric muscles; between these are two thinner ones.

The lining membrane of the gizzard is very hard and thick, and opposite to the digastric muscles two callous spots are formed by the pressure and friction. The muscles take up so much room in the stomach of graminivorous birds that the crop is a necessary appendage to the gizzard, and transmits the food, little by little, to be digested. The food is triturated in the gizzard by the immediate agency of hard foreign bodies, as sand and gravel, which the birds swallow; these bruise the grains of corn by the action of the muscles, and deprive them of their vitality, when the gastric juice acts upon and dissolves them. The pebbles thus perform the vicarious office of teeth.

Hunter inferred that the action of the great digastric muscles of the stomach in birds was rotatory, and says, "Although the motion of the gizzard is hardly visible, yet we may be made very sensible of its action by putting the ear to the side of a fowl while it is grinding its food, when the stones can be heard moving one upon another." The pyloric or intestinal orifice of the gizzard is furnished with a valve, which is of considerable size in those birds which swallow large stones, as the ostrich; it prevents them from passing into the intestines, and it also keeps the food in the stomach until it has undergone a sufficient degree of trituration or mastication to fit it for nutrition.

GLACIERS, a French word received into our language, and which must not be confounded with Glacière, which has a different signification.

The glaciers, as defined by Saussure, are those eternal masses of ice which are formed and remain in the open air in the valleys and on the slopes of lofty mountains.

In speaking of glaciers we generally refer to those of the Alps, as being the best known, though there are many in other places. The glaciers of the Alps have been frequently described by travellers, geographers, and naturalists, but by none in so much detail as by Saussure and Gruner.

If, says Saussure, a spectator could be placed at a sufficient height above the Alps to embrace at one view those of Switzerland, Savoy, and Dauphiné, he would see a mass of mountains intersected by numerous valleys, and composed of several parallel chains, the highest in the middle, and the others decreasing gradually as they recede. The central and highest chain would appear to him bristled with craggy rocks, covered even in summer with snow and ice in all those places that are not absolutely vertical; but on both sides of the chain he would see deep and verdant valleys, well watered and covered with villages. Examining still more in detail, he would remark that the central range is composed of lofty peaks and smaller chains, covered with snow on their tops, but having all their slopes that are not very much inclined covered with ice, while the intervals between them form elevated valleys filled with immense masses of ice, extending down into the deep and inhabited valleys which border on the great chain. The chain nearest to the centre would present to the observer the same phenomenon, but on a smaller scale, beyond which he would see no more ice, nor even snow, save here and there on some of the more elevated summits.

From what precedes, continues Saussure, I recognise two kinds of glaciers, quite distinct from each other, and to which all their varieties may be referred. The first are contained in the valleys more or less deep, and which though at great elevations are still commanded on all sides by mountains higher still; while the second are not contained in the valleys, but are spread out on the slopes of the higher peaks.

The distinguishing features of the two kinds are the greater extent and depth of the former, and the greater compactness of the mass; but as these circumstances seem to depend on the situation of the glaciers, as is proved by the insensible passage of the one kind into the other in many localities, the distinction of Saussure seems to have little foundation.

The formation of the glaciers, whatever are their position and appearance, is due to the great quantity of snow which falls in the high and cold regions of the mountains, and which the heat of summer can but partially thaw. When the slopes of the lofty peaks are very rapid, the snow, being unable to rest upon them, slips down into the valleys in the form of avalanches; and this being added to what falls directly into the valleys, there is accumulated an enormous quantity that becomes compressed by its own weight. This snow is subsequently converted into a kind of ice by the following process:—The rains which occasionally fall, and the water resulting from the partial melting of the snow in the warmer months, percolates the mass, steeping it throughout; and in this state, being seized by the cold of the succeeding winter, it is consolidated into a glacier. It will however be easily conceived that the ice so formed is very different from that found in ponds or lakes; it has neither the hardness, the compactness, the solidity, nor the transparency of the latter, but is, on the contrary, porous and opaque. The water in filtering through the mass not being able to drive out all the air lodged in the interstices, this air, together with that which is liberated during the subsequent congelation, collects into bubbles of various forms and sizes, destroying the transparency and cohesiveness of the mass. With regard to the snow which rests on the slopes, it is evident that it will be subject to the same effect of rain and warmth as that in the valleys, but, from the very position in which it lies, the water in great part runs off, or is only retained towards the bottom of the slope, whence it results that the glaciers so situated are in general of much looser texture than the glaciers of the valleys. It is only towards the bottom, where the water accumulates, that the ice of the former acquires a consistence equal to that of the latter. This solidity decreases as you ascend, till towards the top there is nothing but snow.

The surface of the glaciers depends entirely upon the ground on which they rest. When the bottom is even, or but slightly inclined, the surface of the glacier, though rough and granulated, is also even, presenting but few crevices, and these not wide; but in proportion as the bottom is inclined or rugged the surface is abrupted and uneven. Ebel, who follows Saussure, says, that wherever the slope exceeds 30 or 40 degrees, the beds of ice break into fragments, which get displaced, upheaved, and piled together in every variety of fantastic form, and exhibit immense chasms many feet in breadth, and often more than 100 feet deep.

The splitting of the ice on a change of weather, or in consequence of unequal pressure on an uneven bottom, shakes the very hills, and produces a noise which, reverberated from the mountains, sounds like thunder. The breadth and depth of the chasms thus occasioned vary considerably according to circumstances. Sometimes their dimensions are rapidly increased, either from the slipping away of the lower mass while the upper remains stationary, or in consequence of the erosion of the water running down them from the thawing of the surface; and at other times they are suddenly closed up by the descent of the upper portion against the lower, which is fixed. The ice at those fissures down which the water flows freely is generally transparent, and is observed to be of a greenish colour towards the top and bluish towards the bottom. These clefts are frequently hidden by a covering of snow, which renders them exceedingly dangerous.

Along the anterior edge and lateral margins of some of the larger glaciers there are masses of débris accumulated into the form of long dykes or parapets, which in the Tyrol are known by the name of 'trockne muren,' and in Savoy by that of 'morain,' which has more generally prevailed. In Iceland, where the glaciers are called 'jokül,' the moraines are named 'jokülsgiärde.' The formation of the moraines is easily conceived. When the rocks bordering the glaciers are themselves bare of snow or ice, in consequence of the rapidity of the slope, and are schistose or stratified, they are easily disintegrated by the alternate action of wet and frost, heat and cold, and the fragments thus detached roll down to the lateral edges of the glacier, where the greater part is stopped, while some isolated blocks are urged farther towards the middle. The general inclination of the glacier and its progressive motion downwards also collect a quantity of these débris along the anterior boundary of the ice-field, so that in some cases the whole glacier is entirely surrounded by a moraine. Wherever the mountain-slopes are protected by a glacier of their own, or where the rock is of compact indestructible granite, no moraine is formed. Thus it happens that some glaciers have a moraine on each side, others on one side only, and some none at all. Occasionally also a moraine is found where none could have been formed, in which case it is one that has been brought down from a higher station by the motion of the glacier, as is evident from the nature of the débris. These moraines sometimes attain a height of a hundred feet. It is observable however that when the glaciers have diminished in size, the moraine is above the ice-field; and when, on the contrary, the glacier has increased the moraine is lower than the ice, and in some cases the moraine and the ice are on a level.

M. Agassiz, of Geneva, in a paper on glaciers, moraines, and erratic blocks, published in the 'Bibliothèque Universelle,' No. 24, 1837, has called attention to the existence of moraines at the height of several hundred feet above the bottom of the superior Alpine valleys, where there are no longer any glaciers; but in descending into the lower valleys they are found in succession as high as twelve, fifteen, and eighteen hundred feet. They may even be observed at two thousand feet above the bed of the Rhône, in the neighbourhood of St. Maurice, in the Vallais, and can also be traced at a great height round the Lake of Geneva: from this fact and other collateral circumstances M. Agassiz concludes that at one time the glaciers covered the whole of the plains of Switzerland to a height of 3300 feet above the level of the sea, or 2155 feet above the present surface of the Lake of Geneva, and extended as far as the Jura. To account for the existence of such masses of ice he supposes the alternate cooling and heating of the globe at distant but given periods. He appeals to fossil remains in confirmation of his theory, and tries to explain the existence of the erratic blocks of the Jura by supposing them to be the transported moraines of his immense glaciers.

Besides the bordering moraines there are long and high ridges formed of fragments of rocks, boulders, sand, and earth, in the middle of the glaciers, and at a considerable distance from the margins, to which however they are generally parallel. These banks, which in the German cantons of Switzerland are called 'gufferlinien,' are sometimes numerous and high. Thus, in traversing the great ice-field above Montanvert, Saussure crossed four or five of them which were 30 or 40 feet high, an elevation due in part to the quantity of the débris, and in part to the sinking of the surrounding ice, which thaws, while that under the heap, sheltered from the sun, remains unthawed. The glacier of Rosboden is said to exhibit the greatest number of these ridges, and of the largest dimensions. The formation of these banks is thus explained. The glacier progressively slipping down upon the inclined bottom of the valley recedes from the sides, carrying part of the lateral moraine along with and upon it. This retreat often leaves a considerable space, particularly in the wider valleys, between the foot of the mountains and the edge of the glaciers, which space, during the succeeding winter, becomes filled up with fresh snow, which is converted into ice by the process already described and on which a new moraine is collected. This recedes like the first, and so on; so that were it not that the moraines of the opposite sides sometimes become confounded into one, and because the motion of the ice on the irregular slopes of the valley disturbs the order and parallelism of the banks, they might serve to determine the age of the glaciers.

In winter, as well as in summer, there is continually a quantity of water flowing out from the lower parts of the glaciers, though much less abundantly in the former than in the latter season. This water proceeds from the thawing of the under surface of the glacier, occasioned by subterraneous heat. In the winter it oozes from under the ice in small streamlets; but in the spring and summer months, when it is greatly increased in quantity, it bursts away the ice from before it, and gushes out in plenteous streams from the caverns it has excavated; some of these grottoes are 100 feet high, and from 50 to 80 feet wide, presenting very various and sometimes highly picturesque appearances. The torrents of the glaciers are remarkable for the whitish-blue colour of their waters, which they maintain for a distance of some leagues.

There is a phenomenon, which the Germans call 'gletschergeblase,' which results from the sudden escape of the air imprisoned beneath the glaciers. On a change of temperature this escapes through the crevices in strong currents of insupportably-cold wind, driving like snow-dust the fine icy particles with which it is loaded.

All the Alpine valleys being inclined planes, it is natural to suppose that the glaciers must slip down by their own weight, whenever any circumstance destroys their adhesion to the sides and bottoms of the valleys. This adhesion is constantly diminished, even in the depth of winter, by the natural warmth of the earth, which thaws the under surface of the glacier; but as this takes place only in those parts where the great thickness of the ice protects the soil from the effects of external cold, the mass by this action is but partially disengaged, and therefore still maintains its position. But when the warmth of summer heats the soil all around, and thaws the ice at its surface and edges, the liberation of the glacier goes on with rapidity, aided as it is moreover by the erosion of the underflowing currents, and the abrasion of the lumps of ice and the stones which they bear along. Then it is that the whole mass, obeying the impulse of gravity, slips down and invades the fertile valleys below, presenting the singular spectacle of an ice-field terminating on flowery meadows and contiguous to rich harvests. The limits which the descending glaciers attain are subject to variation.

Great attention has been lately given to the causes of the descent of glaciers. The hypotheses by which the descent of the vast masses of frozen snow down the valleys of the Alps and other mountainous regions has been explained, or attempted to be explained, are essentially two. First, the original notion of Saussure, put in its most original form, that the glacier-masses descended the valleys by the force of gravity; and secondly, the later notion of Charpentier, that the icy masses were pushed down the valleys by an internal expansion caused by congelation of water in their internal cavities. Each of these original notions takes at least two forms. Saussure's hypothesis, indeed, appears in three modifications of importance.

1 A. The view of Mr. R. Mallet, communicated to the Geological Society of Dublin, recognises the descent of the glacier by gravity, but adds the hydrostatic pressure of water below the glacier—upward and forward; and it is impossible to deny to this speculation the merit of removing some considerable difficulty in the reception of the general hypothesis of Saussure.

1 B. The view of Professor James Forbes, who, besides noticing peculiar structures (the blue bands) in the glacier ice, and measuring the velocity of glacier movements in different parts of the valley, and in the central and lateral parts of the 'ice-current' (if we may so speak), has proved the bending of the ice from a straight transverse line during its movements; and has, by means of artificial preparations, imitated some of the peculiar glacial structures. His view is, that glaciers descend the valleys in consequence of so much mutual yielding and adjustment (plasticity) of their parts as to entitle them to be regarded as viscous or semifluid masses, flowing slowly under the influence of gravity.

1 C. Mr. Hopkins, recurring to the original notion of Saussure, maintains the mechanical probability of the glaciers sliding down their containing valleys, as solid bodies; that is to say, sliding in consequence of the general slope of the valley, and not in consequence of the internal displacements and readjustments of the icy mass. Displacements and readjustments happen in this view no less than in Mr. Forbes's hypothesis. The icy mass is subject to extension, to flexure, and fracture under tension, and a variety of accidents, which Mr. Hopkins has employed to explain the unequal rates of movement, the varying forms of fissures, &c. in glaciers. Ice may be regarded as in a certain degree plastic, since it is flexible; but none of these things interfere with the essential condition of this hypothesis, namely, the sliding of the whole ice-mass on its bed. This sliding is in a great measure due to the perpetual slow fusion of the lower surface of the ice, which leaves it in a constant state of disintegration, &c. Mr. Hopkins has made experiments on the sliding of ice; from which it results, that even at angles of inclination from the horizon much below 1 degree, the movement of the ice masses on a rough flagstone, while the lower surface was subject to slow fusion, was very discernible, and found to follow a simple law proportioned to the sine of the angle of inclination.

2 A. The second branch of the hypothesis alluded to, originating with Charpentier, has further ramified into two forms. Charpentier thought the congelation of water in many fissures of the glacier must necessarily urge portions of it forward in the direction of least resistance. But as the glacier is sliding by day and by night, in summer and in winter, sliding unequally in different parts of its descent, and not with such an order of inequality as fits to the hypothesis; and as there is no assignable reason (in this hypothesis) for the formation of new fissures, and the continuation of the process, this whole speculation (the dilation hypothesis) has been abandoned.

2 B. Another form has been given to it by M. Agassiz. This eminent explorer of the Alpine glaciers ascribes their onward movement to congelation of water, not in the cavities of Charpentier, but in minute capillary fissures and spaces among the granular constituent masses of the glacier. With such a power of expansion, altogether independent of gravity, M. Agassiz esteemed it possible to allow of the movement of glaciers, even across level countries, and thus to account for many geological phenomena difficult to be otherwise explained, as erratic blocks and other diluvial phenomena. Mr. Hopkins has, however, exclusively shown that by the means supposed no such power of onward movement can be exercised. Mr. Forbes has proved the actual phenomena of glaciers to be inconsistent with the assumption of such congelation as a cause and with the effects ascribed to it by Agassiz. It is clear from all experiments and mechanical reasonings, that gravity causes the descent of glaciers; but there remain some further researches to be made into the true internal structure of ice, and the true state of the lower surface of glaciers, before we can regard the inquiry as complete.

The most recent writers on the phenomena of the glaciers are the Messrs. Schlagentweit, who have published a work on the 'Physical Geography of the Alps.'

The investigations of Agassiz and others into the history of the glaciers of the Alps, &c., and their former greater extension, have rendered it very probable that this enormous ice-power has been actively at work in early geological periods in situations where now no fields of ice ever occur. Observations of effects such as glaciers are known to produce on surfaces which they traverse; smoothed and rounded rocks—grooved surfaces—striation parallel to the grooves—appear to require the existence and movement of glaciers down some of the valleys which intersect the Snowdonian, the Cumbrian, and Irish mountains. One of the effects attendant on glaciers is the transport of detritus on the surface of the ice till it melts, or in the case of the glacier meeting the sea, breaks off in an iceberg to be drifted by oceanic currents. It is believed by Agassiz that the immense single blocks of stone which lie on the Jura, opposite the valleys of the Alps, have been deposited there by glaciers, not drifted by water-currents, and this speculation he has applied to far greater areas and more difficult cases, such as the accumulation of erratic blocks, gravel mounds, and diluvial heaps in level regions like those which margin the ancient tertiary Bay of Dublin, or abound in the central plains of England. From so great an extension of this speculation, founded as it is on an erroneous hypothesis of glacial movement, Mr. Hopkins's demonstrations warn us to dissent; but if, as may be easily believed, the ancient glacier streams of Cumberland delivered the detrital blocks of Shap and Carrock into the sea by the breaking off of icebergs, these may have been drifted by currents to Staffordshire, to the mouth of the Tyne, and the valleys of York and Holderness.

It may be objected that for such an icy covering to Snowdon and Skiddaw, a great reduction of climate is necessary, and that this is not consonant with the general tenor of geological inferences, which point to more elevated temperatures in early periods. But the reply is easy. The evidence of warm climates in northern zones relied on by geologists applies to far earlier periods; and in respect of this comparatively late period, a reduction of temperature to the extent required for the production of glaciers on the mountains of Wales and Cumberland is perfectly possible by a mere change of the disposition of land and water—since in fact the temperature of the British Islands is now in excess above the mean of their latitude by 5°, 10°, 15°, and more, and this excess is merely due to oceanic currents and other conditions which vary with the distribution of land and water.

Notwithstanding the immense accession of snow and ice which the glaciers receive every winter, and which is much greater than what could possibly be thawed by the mere effect of a short summer in the higher Alpine regions, it is found that they have not sensibly increased. If for one or a few years in succession some of the glaciers are observed to descend lower than usual, they are found in the following years to recede proportionably; thus they are confined within certain limits by a compensating process of nature. The evaporation from ice, and particularly from snow, is considerable even in winter, and goes on with great rapidity in a dry and rarefied air; and subterranean heat, as we have already observed, produces throughout the year a certain diminution of the glaciers at their under surface. In the summer the general thawing of all the parts exposed to the direct rays of the sun, to the warm atmosphere, and to the heated soil at the edges of the glaciers, tends greatly to diminish the quantity of ice—an effect increased by the mechanical action of the torrents which this thawing occasions. But all these causes, powerful as they are, would be insufficient to prevent a constant though gradual increase of the ice, were it not for the advance of the glaciers into the warm atmosphere of the lower valleys. The greater the increase of the preceding winter the greater the pressure from above, and the lower the glacier slips into the thawing region. The farther it slips the greater space is left behind to be filled up, and consequently the greater time must elapse before the mass can again be urged forward. During this time the lower extremity, subjected to the heat of two or three summers, recedes as much as or more than it had before advanced; and thus an admirable compensation is established, by which the cultivated lands of the lower valleys are secured against the unlimited encroachments of the glaciers.

The number and extent of the Alpine glaciers is very considerable. From Mont Blanc to the borders of the Tyrol there are reckoned about 400 glaciers, of which a very few are only 3 miles in length; the greater number range from 10 to 15 miles long, and from a mile to 2½ miles broad. The thickness of some of the glaciers is also very considerable, being from 100 to 600 feet.

It is calculated that the glaciers of the Tyrol, Switzerland, Piedmont, and Savoy form together a superficial extent of 1484 square miles. Such are the great reservoirs whence some of the principal rivers of Europe draw their inexhaustible supplies. It is observable that there are but few glaciers in the direction of east and west.

The above account refers chiefly to the glaciers of the Alps; but as all glaciers, wherever they may be, have the same origin, it is presumable they are also subjected to like influences, and present similar phenomena.

The Pyrenean chain, as also the Sierra Nevada, have glaciers, though they are almost all on the northern slopes, there being none on the southern declivities, except in such places as are sheltered from the sun and south wind by other and more advanced mountains. In the mountains of Norway there are several glaciers. Spitzbergen has its eminences covered with snow and surrounded by glaciers.

In Iceland the glaciers are both numerous and extensive; they generally hang on the rapid slopes of the mountains, and sometimes wholly encase them. These ice-clad elevations are termed Jokūls, the principal of which is that named Klofa Jokūl, in the eastern quarter of the island, and which, according to Henderson, forms, with little or no interruption, a vast chain of ice and snow mountains not less than 3000 miles square. Another, called Blafell's Jokūl, extends from near Tindafiall 100 miles across the island in a westerly and northerly direction, and near the Lake Hvitârvatn presents the most magnificent glaciers. There are numerous other glaciers; many of them, besides the usual phenomena, exhibiting marks of the extraordinary convulsions occasioned by volcanic action and the emission of hot water from the sides of the mountains.

Greenland, as far as is known, contains innumerable glaciers, many of great thickness; and the inhabitants of both the east and west coast are persuaded of their continual increase. It is remarkable that although Graah, in his account of Greenland, describes the glaciers as formed in the same manner with those of the Alps, yet he and all travellers notice the beautiful transparency and consequent compactness of the northern glaciers, and of the icebergs which have been detached from them; a circumstance which seems to denote some peculiar modification of the process of their formation.

Along the south-west coast of South America there are extensive glaciers, as also in the Strait of Magalhaens, and in Tierra del Fuego.

In the Himalayas glaciers have been observed, and all the phenomena presented in Europe have also been found there.

(Saussure, *Voyages dans les Alpes*; Mallet, in *Trans. of the Dublin Geol. Society*; Forbes, in *Jameson's Journal*, and *Tour in the Alps*; Hopkins, in *Cambridge Trans.* and *Phil. Magazine*; Lyell, *Principles of Geology*.)

GLADIOLUS, Corn-Flag (from 'gladius,' a sword, referring to the shape of the leaves), a genus of Plants belonging to the natural order *Iridaceæ*. It has a tubular 2-lipped corolla; segments undulate and unequal; stigma trifid; seeds with an arillus; root a coated bulb; leaves ensiform, sheathing. The species in the gardens are bulbous, and are chiefly brought from the Cape of Good Hope.

G. segetum has about 10 flowers in two rows. The upper division of the corolla is divaricate, the lower segment nearly equal and lanceolate; anthers longer than the filaments; capsules with 3 furrows. It has been supposed to be an aphrodisiac, a reputation obtained from its acrid qualities, which are however common to the whole of the order. The Hottentots eat the tubers or corms of several species of this genus, the starch they contain rendering them nutritious.

G. triphyllus has about 3 flowers in one row; the anthers much shorter than the filaments. It is found in the mountains of Carrara.

G. palustris has 3 or 4 flowers, secund; the tube twice as long as the seed-vessel; the claw of the middle division curved and remote; the lobes of the stigma papilloso-ciliate almost from the base; anthers shorter than the filaments; auricles at the base obtuse, parallel; capsules oblong, obovate, rounded at the top, marked with six equal furrows. It is found in Germany.

G. communis has secund flowers; the filaments half as long again as the anthers; auricles at the base obtuse and parallel; the tube half as long again as the germen; lobes of the stigma gradually broader upwards, papilloso-ciliate almost from the base; capsules 3-edged, obovate, impressed at the top; the seeds broadly winged. It is found near Stettin and Frankfurt-on-Oder.

G. Illyricus has secund flowers; the tube three times as long as the germen; division of stigma linear from the base to the middle, and with a smooth margin suddenly enlarged at the top with a papilloso-ciliate margin; the capsules obovate, 3-edged. A native of Illyria.

G. imbricatus has secund approximate flowers; the tube nearly three times as long as the germen; the division of stigma gradually broader upwards, papilloso-ciliate almost from the base; the capsules with 3 rounded angles. Found in Bohemia and Silesia.

G. infestus has a lax spike; flowers 4 to 14, obliquely alternate; division of corolla alternately pink and purple, uppermost very broad, covering the 2 lateral ones, the 3 lower unequal; anthers about as long as the filaments; seeds globose, prolonged downwards. It is a native of Sicily.

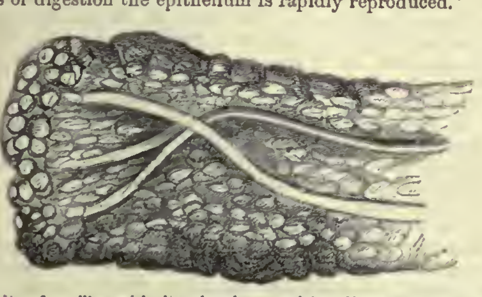
G. Byzantinus has numerous flowers in two rows; the upper segment of the corolla covered by the lateral ones; the lower division lanceolate, the middle largest; the anthers longer than the filaments; seeds winged; leaves long, ensiform, and linear. Found in Sicily.

GLAND, a term applied to cells and collections of cells in the animal body, which have the power of absorbing or separating the various substances which pass into or are separated from the circulating fluid. In one sense all the cells of the animal act as glands, for they separate from the blood the peculiar substances of which they are composed. The term gland however is only strictly applied to special forms of tissue which separate peculiar matters. "A true gland," says Dr. Carpenter, "may be said to consist of a closely packed collection of follicles, all of which open into a common channel, by which the product of the glandular action is collected and delivered. The follicles contain the secreting cells in their cavities, whilst their exterior is in contact with a network of bloodvessels from which the cells draw the materials of their growth and development."

In a wider sense however the term gland has been applied to those parts of the body which are engaged in absorbing the food or carrying to the blood the materials of used-up tissues. [ABSORBENT SYSTEM; ABSORPTION]. In all cases the cell is an active agent whether of absorption or separation. The agency of the cell in absorption is seen in the way in which the chyle is taken from the intestines and carried into the lacteals.

Professor Goodsir has recently shown that there is a continual development of cells at the extremity of each villus in the small intestine, and that these cells are the agents by which the secretion of the nutritious fluid is accomplished, and by which it undergoes its first preparation for the purposes it is subsequently to fulfil. The nature of this process we give in Professor Goodsir's own words, omitting those portions which do not bear specially on the point.

"As the chyle begins to pass along the small intestine, an increased quantity of blood circulates in the capillaries of the gut. In consequence of this increased flow of blood, or from some other cause with which I am not yet acquainted, the internal surface of the gut throws off its epithelium, which is intermixed with the chyme in the cavity of the gut. The cast-off epithelium is of two kinds,—that which covers the villi, and which, from the duty it performs, may be named protective epithelium; and that which lines the follicles, and is endowed with secreting functions. The same action then, which in removing the protective epithelia from the villi prepares the latter for their peculiar function of absorption, throws out the secreting epithelia from the follicles, and thus conduces towards the performance of the function of these follicles. The villi, being now turgid with blood, erected, and naked, are covered or coated by the whitish-gray matter already described. This matter consists of chyme, of cast-off epithelia of the villi, and of the secreting epithelia of the follicles. The function of the villi now commences. The minute vesicles which are interspersed among the terminal loops of the lacteals of the villus, increase in size by drawing materials from the blood through the coats of the capillary vessels, which ramify at this spot in great abundance. While this increase in their capacity is in progress, the growing vesicles are continually exerting their absorbing function, and draw into their cavities that portion of the chyme in the gut necessary to supply materials for the chyle. When the vesicles respectively attain in succession their specific size, they burst or dissolve, their contents being cast into the texture of the villus, as in the case of any other species of interstitial cell. The débris, and the contents of the dissolved chyle-cells, as well as the other matters which have already subserved the nutrition of the villus, pass into the looped network of lacteals, which, like other lymphatics, are continually employed in this peculiar function. As long as the cavity of the gut contains chyme, the vesicles of the terminal extremity of the villi continue to develop, to absorb chyle, and to burst, and their remains and contents to be removed along the lacteals. When the gut contains no more chyme, the flow of blood to the mucous membrane diminishes, the development of new vesicles ceases, the lacteals empty themselves, and the villi become flaccid. The function of the villi now ceases till they are again roused into action by another flow of chyme along the gut. During the intervals of absorption, it becomes necessary to protect the villi from the matters contained in the bowel. They had thrown off their protective epithelium when required to perform their functions, just as the stomach had done to afford gastric juice, and the intestinal follicles to supply their peculiar secretions. In the intervals of digestion the epithelium is rapidly reproduced."



Extremity of a villus with its absorbent vesicles distended with chyle, and the trunks of its lacteals seen through its coats. Very highly magnified.

The researches of Professor Goodsir have likewise thrown much light on the general process of secretion. He shows, by an admirably selected series of observations (chiefly on the lower animals), that secretion is a function of the nucleated cell.

If the membrane which lines the secreting portion of the internal surface of the ink-bag of *Loligo sagittata* (Lamarck) be carefully freed from adhering secretion by washing, it will be found to consist almost entirely of nucleated cells, of a dark brown or black colour. These cells are spherical or ovidal. Their nuclei consist of cells grouped together in a mass. Between these composite nuclei and the walls of their containing cells is a fluid of a dark brown colour. This fluid resembles in every respect the secretion of the ink-bag itself. It renders each cell prominent and turgid, and is the cause of its dark colour.

The dilated terminal extremities of the ducts in the liver of *Helix aspersa* (Müller) contain a mass of cells. If one of these cells be isolated and examined, it presents a nucleus consisting of one or more cells. Between the nucleus and the wall of the containing cell is a fluid of an amber tint, and floating in this fluid are a few oil-globules. This fluid differs in no respect from the bile as found in the ducts of the gland. The liver of *Modiola vulgaris* (Fleming) contains masses of spherical cells. Between the nucleus and the wall of each of these cells a light-brown fluid is situated, bearing a close resemblance to the bile in the gastro-hepatic pouches. The nucleated cells which are arranged around the gastro-hepatic pouches of *Pecten opercularis* are irregular in shape, and distended with a fluid resembling the bile. The hepatic organ which is situated in the loop of intestine of *Pirena prunum* (Fleming) consists of a mass of nucleated cells. These cells are collected in groups in the interior of larger cells or vesicles. These nucleated cells are filled with a light-brown bilious fluid. The hepatic organ situated in the midst of the reproductive apparatus, and in the loop of the intestine of *Phallusia vulgaris* (Forbes and Goodsir), consists of a number of vesicles, and each vesicle contains a dark-brown bilious fluid.

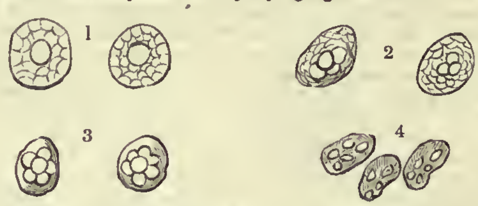
The hepatic cæca in the liver of *Patella vulgata* contains vesicles inclosing a body which consists of a number of nucleated cells full of a dark fluid resembling the bile. The kidney of *Helix aspersa* (Müller) is principally composed of numerous transparent vesicles. In the centre of each vesicle is situated a cell full of a dead white granular mass. This gland secretes pure uric acid. The ultimate elements of the human liver are nucleated cells. Between the nucleus and the cell-wall is a light brown fluid with one or two oil globules floating in it. The vesicular cæca in the testicle of *Squalus cornubicus* contain nucleated cells, which ultimately exhibit in their interior bundles of spermatozoa. The generative cæca of *Echiurus vulgaris* (Lamarck) contain cells full of minute spermatozoa. *Aplysia punctata* secretes from the edge and internal surface of its mantle a quantity of purple fluid. The secreting surface of the mantle consists of an arrangement of spherical nucleated cells. These cells are distended with a dark purple matter. The edge and internal surface of the mantle of the *Janthina fragilis* (Lamarck), one of the animals which supplied the Tyrian dye, secretes a deep bluish-purple fluid. The secreting surface consists of a layer of nucleated cells, distended with a dark purple matter. If an ultimate acinus of the mammary gland of the bitch he examined during lactation it is seen to contain a mass of nucleated cells. These cells are generally ovoidal, and rather transparent. Between the nucleus and the cell-wall of each a quantity of fluid is contained, and in this fluid float one, two, three, or more oil-like globules, exactly resembling those of the milk.

The secretion within a primitive cell is always situated between the nucleus and the cell-wall, and would appear to be a product of the nucleus.

The ultimate secreting structure then is the primitive cell, endowed with a peculiar organic agency, according to the secretion it is destined to produce. Mr. Goodsir names it the primary secreting cell. It consists, like other primitive cells, of three parts—the nucleus, the cell-wall, and the cavity. The nucleus is its generative organ, and may or may not, according to circumstances, become developed into young cells. The cavity is the receptacle in which the secretion is retained till the quantity has reached its proper limits, and till the period has arrived for its discharge. Each primary secreting cell is endowed with its own peculiar property, according to the organ in which it is situated. In the liver, it secretes bile; in the mamma, milk, &c. The primary secreting cells of some glands have merely to separate from the nutritive medium a greater or less number of matters already existing in it. Other primary secreting cells are endowed with the more exalted property of elaborating from the nutritive medium matters which do not exist in it. The discovery of the secreting agency of the primitive cell does not remove the principal mystery in which this function has always been involved. One cell secretes bile, another milk; yet the one cell does not differ more in structure from the other than the lining membrane of the duct of one gland from the lining membrane of the duct of another. The general fact however that the primitive cell is the ultimate secreting structure is of great value in physiological science, inasmuch as it connects secretion with growth, as phenomena regulated by the same laws. The force, of whatever kind it may be, which enables one primary formative cell to produce nerve and another muscle, by an arrangement within itself of the common materials of nutrition, is identical with that force which enables one primary secreting cell to distend itself with bile and another with milk.

Instead of growth being a species of imbibing force, and secretion on the contrary, a repulsive, the one centripetal, the other centrifugal, they are both centripetal. Even in their latter stages the two processes, growth and secretion, do not differ. The primary formative cell after becoming distended with its peculiar nutritive matter, in some instances changes its form according to certain laws; and then, after a longer or shorter period, dissolves and disappears in the intercellular space in which it is situated; its materials passing into the circulating system if it be an internal cell, and being merely thrown off if it be an external cell. The primary secreting cell, again, after distension with its secretion does not change its form so much as certain of the formative cells, but the subsequent stages are identical with those of the latter. It bursts or dissolves, and throws out its contents either into ducts or gland-cavities.

The general fact of every secretion being formed within cells explains a difficulty which has hitherto puzzled physiologists, namely, why a secretion should only be poured out on the free surface of a gland-duct, or secreting membrane. We have attempted to illustrate Mr. Goodsir's views by the accompanying figures :—



1. Cells from the kidney of *Helix aspersa*. The contained secretion is dead-white and presents a chalky appearance.
2. Cells from the ink-bag of *Loligo sagitta*.
3. Cells from the liver of the *Patella vulgata*. In this instance the bile is contained in the cavities of the secondary cells, which constitute the nucleus of the primary cell.
4. Cells from the mamma of a bitch. In addition to their nuclei these cells contain milk-globules.

After describing the development of glandular tissue Professor Goodsir concludes his paper on this subject with the following remarks :—

"It appears to be highly probable therefore that a gland is originally a mass of nucleated cells, the progeny of one or more parent cells; that the membrane in connection with the embryo gland may or may not, according to the case, send a portion of the membrane in the form of a hollow cone into the mass; but whether this happens or not, the extremities of the ducts are formed as closed vesicles, and then nucleated cells are formed within them, and are the parents of the epithelium cells of the perfect organ. Dr. Allen Thomson has ascertained that the follicles of the stomach and large intestines are originally closed vesicles. This would appear to show that a nucleated cell is the original form of a follicle, and the source of the germinal spot, which plays so important a part in its future actions. The ducts of glands are therefore intercellular passages. This is an important consideration, inasmuch as it ranges them in the same category with the intercellular passages and secreting receptacles of vegetables.

"Since the publication of my paper on the secreting structures, in the 'Transactions of the Royal Society of Edinburgh,' in 1842, I have satisfied myself that I was in error in attributing to the cell-wall the important function of separating and preparing the secretion contained in the cell-cavity. The nucleus is the part which effects this.

The secretion contained in the cavity of the cell appears to be the product of the solution of successive developments of the nucleus, which in some instances contains in its component vesicles the peculiar secretion, as in the bile-cells of certain *Mollusca*; and in others becomes developed into the secretion itself, as in seminal cells. In every instance the nucleus is directed towards the source of nutritive matter; the cell-wall is opposed to the cavity into which the secretion is cast. This accords with that most important observation of Dr. Martin Barry on the function of the nucleus in cellular development. I have also had an opportunity of verifying—and to an extent which I did not at the time fully anticipate—the remarkable vital properties of the third order of secretion referred to in the memoir to which I have just alluded. The distinctive character of secretions of the third order is, that when thrown into the cavity of the gland they consist of entire cells, instead of being the result of partial or entire dissolution of the secreting cells. It is the most remarkable peculiarity of this order of secretions, that, after the secreting cells have been separated from the gland and cast into the duct, or cavity, and therefore no longer a component part of the organism, they retain so much individuality of life as to proceed in their development to a greater or less extent in their course along the canal or duct before they arrive at their full extent of elimination. The most remarkable instance of this peculiarity of secretions of this order is that discovered by my brother. He has observed that the seminal secretion of the decapodous crustaceans undergoes successive developments in its progress down the duct of the testis, but that it only becomes developed into spermatozoa after coitus, and in the spermatheca of the female. He has also ascertained that, apparently for the nourishment of the component cells of a secretion of this kind, a quantity of albuminous matter floats among them, by absorbing which they derive materials for development after separation from the walls of the gland. This albuminous matter he compares to the substance which, according to Dr. Martin Barry's researches, results from the solution of certain cells of a brood, and affords nourishment to their survivors. It is one of other instances in which cells do not derive their nourishment from the blood but from parts in their neighbourhood which have undergone solution, and it involves a principle which serves to explain many processes in health and disease.

"I conclude therefore, from the observations which I have made, 1st, that all the true secretions are formed or secreted by a vital action of the nucleated cell, and that they are first contained in the cavity of that cell; 2nd, that growth and secretion are identical—the same vital process under different circumstances."

Having thus examined the nature of the process by which the cell secretes, we may now refer to some of the more prominent modifications of the organs called glands. The simplest condition of a Gland is the simple inversion of a secreting membrane called a follicle. These occur in the skin, as in the sebaceous follicles, and also in the mucous membrane of the stomach, where they are called gastric follicles. In these cases we have simply a pit in the membrane covered with secreting cells. In the early stages of the development of all glands we have this simple condition, and in the permanent condition of the more complicated glands, when occurring in the lower animals, we have the same simple development. Thus the liver in some of the Polypes and lower *Mollusca* consists merely of a series of separate follicles placed in the walls of the stomach. The chick whilst in the egg presents the same condition of this organ. The same simplicity is seen in the commencement of the development of a mammary gland in the *Mammalia*. In the *Ornithorhynchus* this organ consists of a mere cluster of blind sacs. In the same way in many fishes the pancreas begins its existence as a mere group of blind follicles. The next stage in the complexity of a gland is where a number of follicles open into a single tube. Such a condition of the gland is seen in what are called the Meibomian glands of the eye. The larger glands of the body, as the pancreas, liver, and parotid gland, are but mere complicated stages of this process. Innumerable follicles empty themselves into tubes which again empty themselves into other tubes until the whole contents of the gland are thrown out from some common outlet.

For further information on the subject of the Glandular System see LIVER; PANCREAS; BILE; PAROTID; DIGESTION; SECRETION; ABSORBENT SYSTEM; SALIVA; KIDNEYS; URINE; SKIN.

GLAPHYRIA, a genus of Plants belonging to the natural order *Myrtaceæ*. The limb of the calyx is 5-lobed, petals 5, berry 5-celled, many seeded; seeds fixed to the axis, 2 rows in each cell. The species are small Indian trees, with alternate minutely-stipitate leaves, and few-flowered axillary peduncles.

G. nitida is called by the Malays 'the Tree of Long Life,' probably from its maintaining itself at elevations where the other denizens of the forest have ceased to exist. It affords at Bencoolen a substitute for tea, and is known by the name of the Tea Plant. Various species of *Leptospermum* and *Melaleuca* bear the same name in the Australian colonies.

G. sericea has lanceolate acuminated leaves. It is a native of Pulo Penang and on the west coast of Sumatra. The calyx, peduncles, bracts, and young leaves are silky; the petals and cells of ovarium 5 or 6 in number.

GLAREOLA. [CHARADRIADÆ.]

GLASSWORT. [SALICORNIA.]

GLAUBER SALT, native Sulphate of Soda. It is monoclinate, and occurs in oblique rhombic prisms. It is found in efflorescent crusts, of a white or yellowish-white colour, also in mineral waters. Its taste is cool, saline, and bitter. It is distinguished from Epsom salt by its coarse crystals and the yellow colour it gives to the blowpipe flame. The artificial salt was first discovered by Glauber, a German chemist. It is found in sea-water, and is obtained from this source for use in medicine and the arts. At Kailua, in Hawaii, one of the Sandwich Islands, it is found abundantly in a cave, where it is constantly forming. It is also found in Austria and Hungary, and the United States of America.

GLAUBERITE, a native Sulphate of Lime and Soda. It occurs in oblique crystals, which are usually flattened, with sharp edges; nearly transparent, and yellowish-gray in colour. The taste is weak, and slightly saline. It is found in rock-salt at Villa Rubia in Spain, at Aussee in Upper Austria, and Vic in France.

GLAUCIUM (from γλαυκός, 'sea-green, or glaucous,' in allusion to the colour of the plant and its habitation by the sea-side), a genus of Plants belonging to the natural order *Papaveraceæ*. It has 2 sepals, 4 petals, and indefinite stamens; elongated 2-valved capsules, a bilamellate stigma, and ovate reniform seeds. The species are evergreen glaucous biennial or annual herbs, abounding in a copper-coloured acrid juice, said to be poisonous and to occasion madness. The flowers are yellow or crimson; and the English name of the genus, Horn-Poppy, originates in the horn-like shape of the pods.

G. luteum, Yellow Horn-Poppy, has a smooth stem and a tubercular scabrous pod. The flowers are large, and of a golden-yellow colour. It is found on the sandy sea-shores of Great Britain, and also in the Carolinas and Virginia. It is the μήκων κερατῖτις of Theophrastus ('Hist. Plant.,' 9, 13).

G. phœniceum is regarded by De Candolle as a variety of *G. corniculatum*. It is a native of the south of Europe, and is occasionally found on the coast of England. It is however considered by Babington to be a doubtful native. The flowers are crimson, and have an elegant appearance. Don enumerates six species of *Glaucium*, none of which however are applied to any useful purposes. The species of Horn-Poppy thrive well in any common garden-soil, and may be easily raised from seeds, which ripen in great abundance.

(Don, *Dichlamydeous Plants*; Babington, *Man. Brit. Bot.*)

GLAUCOLITE. [LABRADORITE.]

GLAUCONIE, a French term used principally by M. Brongniart, to signify some stratified deposits associated with the chalk, which correspond to the greensands of English geologists. The Glauconie Crayeuse is considered by M. Brongniart to be the equivalent of the upper greensand, and the Glauconie Sableuse of the lower greensand. The same author uses the term Glauconie Grossière for a deposit above the chalk.

GLAUCONOME (*Glauconome*, Nereidis filia), is used to denote a genus established by Goldfuss, for species of Celluliferous *Polyparia* found in the chalk of Westphalia.

Glauconome is also the name of a fresh-water genus of conchifers of the family *Veneridæ*, established by Dr. Gray in his 'Spicilegia Zoologica.' [VENERIDÆ.]

GLAUCO'PIS, a genus of Birds established by Forster (*Calæas* of Bechstein and Vieillot), belonging to the order *Insessores*.

It has the following generic character:—Bill moderate, strong, robust, thick, with the base enlarged towards the commissure; upper mandible convex, vaulted, curved towards the end, and without any notch; lower mandible following the curvature of the upper, straight below, hidden in part by the sides of the upper mandible. Nostrils basal, lateral, round, partially closed by a large membrane, and entirely hidden by the curled and velvetty feathers which advance from the forehead. Feet strong, robust; tarsi longer than the middle toe; toes nearly all of a length, the external toe united to the middle one, and the internal toe soldered (soudé) at the base. Wings short; the first quill short, the three following graduated, and the fifth longest. Tail long, graduated. (Temminck.) The above character is adopted in Lesson's 'Manuel,' and the following three species are there arranged under the genus, namely, *G. cinerea*, *G. leucoptera*, and *G. Temnura*.

M. Temminck describes *G. Temnura* as one-third larger than *G. Temia* (*Corvus varians* of authors), or the Pie Temia of Le Vaillant's 'Birds of Africa.' He observes that the striking character in *G. Temnura* consists in a very graduated tail (queue très étagée), all the feathers of which are truncated and cut, as it were, transversely at their extremity. The whole of the plumage is black, a little lustrous on the wings and tail. Bill and feet black. Total length 12 inches. It is found in Cochin China. M. Lesson observes that this species will form a new genus.

In Mr. Swainson's 'Classification of Birds,' vol. ii., part 4, *G. Temnura* is referred to *Crypsirina*, and the following generic character is given by him: some of the characters, not inserted in his own notes, rest on the authority of the 'Manuel d'Ornithologie.'

Glaucopis (Forster). Bill short, strong, robust; the culmen elevated and curved from the base; upper mandible destitute of a notch; under mandible straight (on the gonys), the margin covered by that of the upper and furnished at the base with two fleshy wattles.

Nostrils basal, lateral, partly closed by a large membrane. Feet very strong, formed for walking. The tarsus longer than the middle toe; lateral toes short, of equal length, and divided to their base; hind toe strong, armed with a long curved claw. Wings short. Tail rather lengthened, rounded; the feathers ending in setaceous points.

Glaucopis Temnura. (Temm.)

In the third part of the 'Classification of Birds,' in the same vol., Mr. Swainson states that the *Glaucopinæ*, or Rasorial Crows, form the only division of the family which he had then analysed with a view to determine its chief generic types. As a whole he thinks that they are distinguished from all other birds by their short finch-like bill, the commissure of which is always arched, and sometimes sinuated like that of a *Fringilla*. The genus *Glaucopis*, which he considers the pre-eminent type, shows this structure, in his opinion, in great perfection, "added to another which is equally indicative of the rasorial structure, that is, strong walking legs. Following this we have the Senegal Piapec, forming our genus *Ptilostomus*, intimately related, according to M. Temminck, with his *Corvus gymnocephalus*." [Corvidæ.] "Upon this authority we conjecture the last-mentioned bird may prove the grallatorial type. The singular genus *Brachystoma*, from New Holland, long since noticed by us as connecting this bird with the jays, leads at once to the Finch Crows of India, all of which, in our opinion, are merely variations of that type named *Crypsirina* by M. Vieillot. Some of these, from their close resemblance to *Glaucopis*, have actually been placed in that genus by M. Temminck, who seems to have overlooked the entirely different structure of their legs. The circle is thus closed, and we find that these five types represent the primary divisions of the whole class."

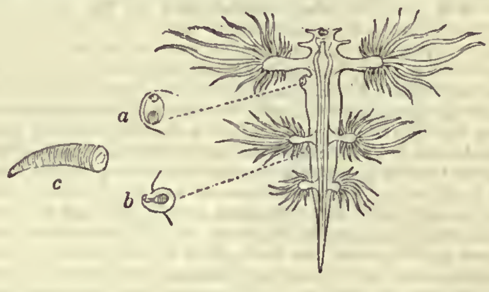
The following are Mr. Swainson's views of the position of the *Corvidæ*:—He is of opinion that the *Corvidæ* are nearest allied to the Hornbills, although the intervening forms are few. The genus *Frigillus* (*Fregilus*?) is the only representative he at present knows of that sub-family which intervenes between the *Buceridæ* and the *Corvinæ*. He observes that the whole family has never yet been analysed, so that the leading divisions alone can yet be made out or stated with any degree of certainty; and says that the little value which can be attached to speculations on the rank of the present genera, founded upon mere synthesis, will best appear by looking to those artificial arrangements that place short-legged Rollers close to the long-legged and powerfully constructed Grakle (*Gracula religiosa*), two genera moreover which analysis has convinced him do not belong to this family. "Nothing in short," continues Mr. Swainson, "is more easy than to divide a group like this into three, five, seven, or any other given number; but the divisions must always be considered as temporary, until confirmed by analysis. We have not yet carried our investigations so far as to lay before the reader an arrangement of all the genera of this family; nor will our space admit of an attempt to demonstrate those groups in it which we have already marked out. We shall therefore merely intimate what we conceive to be the only natural series, by arranging the genera, in our synopsis, under the following sub-families:—1, *Frigillinæ* (*Fregilinæ*?); 2, *Corvinæ*; 3, *Garrulinæ*; 4, *Crypsirinæ*; and 5, *Coracinæ*."

He excludes from the family *Epimachus*, as belonging to the Suctorial Birds; *Coracias*, as being completely united to *Eurystomus* by two species; and *Gracula*, as united to *Pastor* among the *Sturnidæ*. The Paradise Birds, hitherto arranged with the Crows, form, in his opinion, the most aberrant group of his *Tenuirostres*, and one placed between the Hoopoes and the Honey-Suckers. From the Crows he proceeds to the Starlings (*Sturnidæ*).

In the 'Synopsis of a Natural Arrangement of Birds' (part iv. of the same vol.), Mr. Swainson observes that "there are a few alterations in the arrangement of the groups from what they appear in the foregoing part: this has resulted from further analysis, and by incorporating our researches up to the latest time." We here find the *Corvidæ* thus arranged: Sub-family *Corvinæ*, Typical Crows—*Corvus*, *Pica*, *Nucifraga*, *Barita*, *Vanga*, *Platylophus*, *Phonygama*. Sub-family *Garrulinæ*, Jays—*Garrulus*, *Cyanurus*, *Dysornithia*. Sub-family *Glaucopinæ*, Wattle Crows—*Crypsirina*, *Ptilostomus*, *Brachystoma*, *Glaucopis*. Sub-family *Coracinæ*, Fruit Crows—*Coracina*, *Cephalopterus*, *Gymnocephalus*. Sub-family *Frigillinæ* (*Fregilinæ*?) which, he remarks, contains at present but two European birds (*F. Pyrrhocorax* and *F. erythropus*), which almost appear to be types of as many genera. The characters which he gives are, he observes, more strictly applicable to the first. [Corvidæ; Coracina.]

GLAUCUS, a genus of Molluscous Animals named by Forster, and placed by Cuvier among his *Nudibranchiata*; by De Blainville under his *Polybranchiata* (Family *Tetracerata*); and by Rang made the type of a family, Les Glauques (*Glaucidæ*), which together with *Glaucus* comprises the genera *Laniogerus*, De Blainville; *Briaræa*, Quoy and Gaimard; *Eolidia*, Cuvier; *Cavolina*, Bruguières; and *Tergipes*, Cuvier.

It has the following generic characters:—Animal gelatinous, elongated, slightly flattened, and terminated backwards in a point. Foot very narrow and almost rudimentary. Head distinct, furnished with four very short flattened and triangular tentacula; the mouth subterminal. Branchiæ disposed in pairs on the sides, and fitted for swimming, being formed by oblong processes (palettes oblongues) surrounded by digitated appendages. Termination of the organs of generation in a common tube at the anterior part of the right side; vent on the same side, more backwards. (Rang.)



Glaucus.

a, common tubercle of the organs of generation; *b*, vent; *c*, one of the digitations magnified. (De Blainville.) *a* would represent the anus, according to Mr. Bennett.

Deshayes, in his edition of Lamarck (who made *Glaucus* the first genus of his family Tritonians), remarks, that, notwithstanding the researches of several accomplished naturalists, there still exists uncertainty as to many points of the anatomy of this genus. The description of M. De Blainville, he observes, leaves doubts concerning the organs of respiration; nor is it, he adds, certain that the digitations of the fins are branchiæ: in the opinion of M. Deshayes they are not. M. Quoy, he continues, says that these digitations are very caducous in the living animal, which detaches them when they are touched; and it is not to be believed that this would take place if these parts were destined for so important a function as that of respiration. M. Deshayes therefore points out the necessity of new researches as to the organisation of these animals. The same zoologist states that the majority of naturalists are now convinced that as yet but one species is known; and he adds, that it must be confessed that the figures given are very inexact, with the exception of that given by Messrs. Quoy and Gaimard ('Voy. de l'Astr.,' Zool. t. 2, pl. 21, f. 6 to 14), which conveys a good idea of this elegant animal.

Mr. G. Bennett states that during a voyage from England to Sydney, in 4° 26′ N. lat., 19° 30′ W. long., with light airs and calms prevailing at the time, a number of damaged and perfect specimens of the *Glaucus hexapterygius* (Cuvier), were caught in the towing-net, and placed in a glass of sea-water, where they resumed their vital actions and floated about, exhibiting a brilliancy of colour and peculiarity of form that excited admiration. The back of the animal, as well as the upper surface of the fins and digitated processes, and the upper portion of the head and tail, were of a vivid purple colour, varying occasionally in its intensity, appearing brighter in colour when the animal was active or excited, and deeper when it remained floating tranquilly upon the surface of the water. The abdomen and under surface of the fins were of a beautiful pearly white colour, appearing as if it had been enamelled. The usual length of Mr. Bennett's specimens, measured from the extremity of the head to the tail, when extended floating upon the surface of the water, was one inch and three-quarters, sometimes one or two lines more or less. Mr. Bennett describes the body of the animal as subcylindrical, terminating in a tail, which gradually becomes more slender towards the extremity until it finally terminates in a delicate point; the head is short, with very small conical tentacula in pairs, two superior and two inferior; three (and in *G. octopterygius*, Cuvier, four) branchial fins on each side, opposite, palmated, and digitated at their extremities, the number of digitations varying, the central digitations being the longest, and the first branchial fins, or those nearest the head, larger and more dense than the others. The body is gelatinous, and covered, he says, by a thin and extremely sensible membrane. "When taken in the hand," continues Mr. Bennett, "the under surface of the animal soon becomes denuded of the beautiful pearly white it previously had, and at that time appears like a small transparent bladder, in which a number of air-bubbles are observed together with the viscera. On the abdomen being laid open a large quantity of air-bubbles escaped; and perhaps a query may arise how far they assist the animal in floating upon the surface of the water. The figure of *Glaucus hexapterygius* in Cuvier's work 'Sur les Mollusques' is tolerably well executed, but no engraving can convey to the beholder the inconceivable delicacy and beauty of this mollusk. In the engraving alluded to there is an inaccuracy, at least as compared with the specimens before me, in the digitated processes of the fins not being sufficiently united at the base: in the living specimens before me they were united together at the base, and then branching off became gradually smaller until they terminated in a fine point. Again, in the engraving in Cuvier's work the anal orifice is placed on the right side, whereas in my specimens it was situated on the left; for in all the specimens I examined I found the anus was disposed laterally, and could be plainly distinguished situated on the left side of the animal, a little below the first fin. This I consider also the orifice of generation, as in some of the specimens examined a rather long string of dots resembling ova was seen to protrude from it. One of the animals discharged from this orifice a large quantity of very light brownish fluid; this no doubt was the fæces."

Numbers of the same species were taken by the same zoologist towards the end of the same month in 2° 26′ N. lat., 19° 51′ W. long., light airs, nearly calm. Often when at rest the animal would drop one or more of the fins, but on touching them they would be immediately raised to their former position, and the fin was turned back as if to throw off the offending object. From Mr. Bennett's observations It appears that the *Glauci* actually feed upon *Porpitæ*, and probably upon *Velellæ* and *Janthinæ;* that the animal shows more sensitiveness on the back than it does when touched elsewhere; that it does not seem to be disturbed by the contact of another *Glaucus;* that the fins have an undulating and a twisting movement; and that a circulating fluid could be perceived by means of a glass through the semi-transparent membrane of the back, close to the surface, flowing in two directions—one taking a course downwards and the other upwards. It appears moreover, from the testimony of Mr. Bennett and others, that no means have yet been discovered for preserving these evanescent creatures, which lose their beauty and form even when taken alive out of the water and laid upon the hand. "The digitations of the fins fell off, the least movement destroyed the beauty of the animal; it speedily lost all the deep purple and silvery enamelled tints, and became a loathsome mass." ('Zoological Proceedings,' 1836.) Spirit, it is to be feared, would never preserve them in a state available for examination. We mention this to induce those observers who may have the opportunity, to follow out their researches on the animal's organisation, by watching it narrowly with good glasses whilst it is alive.

GLAUX, a genus of Plants belonging to the natural order *Primulaceæ*. It has a bell-shaped calyx, 5-parted, coloured, and without any corolla, by which peculiarity it is distinguished from all other plants of the same order. There are 5 stamens inserted at the base of the calyx; the capsules are few-seeded, opening with 5 valves. There is but one species of this genus.

G. maritima, the Black Saltwort, has a procumbent stem, opposite ovate glabrous leaves, axillary sessile pink flowers with obtuse segments. It grows on the sea-shore and salt-marshes, and is a native of Great Britain.

(Babington, *Manual of British Botany*.)

GLEAD. [FALCONIDÆ.]

GLECHOMA. [NEPETA.]

GLEDITSCHIA, a genus of Plants named in honour of Gottlieb Gleditsch, a professor at Berlin, and author of a work on the sexual system of Linnæus entitled 'Consideratio epicriseos Siegesbeckianae in Linnaei systema plantarum sexuale et methodum botanicam.' (Bischoff, p. 562.) He was a good botanist, and contributed a valuable paper on the reproductive organs of the *Fungi* to the 'Transactions of the Berlin Academy' in 1748. This genus belongs to the natural order *Leguminosæ* and the sub-order *Cassieæ*. The flowers are unisexual, the calyx has 3-4-5 equal sepals, which are connected together at the base into a cupule. The petals are equal in number to the sepals; two of them are connected into a carina. The leaves are abruptly pinnate and bipinnate on the same tree. The flowers have a greenish colour, and are disposed in spikes.

G. triacanthos, the Three-Horned Acacia or Honey Locust, is a large tree, native of the Carolinas and Virginia, and attaining a height of from 50 to 80 feet. When the tree is young, the trunk and branches are covered with small prickles, which become hard as it increases in age, and form a formidable defence. The foliage is of a light shining green, and is particularly elegant. In the neighbourhood of London the leaves do not appear until late in the spring, and drop off early in the autumn. The seeds are covered with a sweet pulp, which, when infused and fermented, forms an intoxicating liquor which was used by the American Indians.

G. monosperma, the One-Seeded Gleditschia, is a native of the Carolinas, Florida, and Illinois, in damp woods. It attains a height of from 60 to 80 feet, and much resembles the former species. When none of the seeds ripen it is impossible to distinguish them. There are 8 species of *Gleditschia* enumerated, all of which possess the same general characters. As ornamental trees they are much esteemed, both on account of their elegant foliage and the varied and picturesque forms assumed by the tree, together with the singular appearance of the spines. They require a deep rich soil in a situation not exposed to high winds.

(Loudon, *Encyclopædia of Trees and Shrubs;* Don, *Dichlamydeous Plants.*)

GLEICHENIACEÆ, an order of Plants constituted by Von Martius, and forming part of Lindley's alliance *Filicales* in the 'Natural System.' In the 'Vegetable Kingdom' it is reduced to the rank of a tribe under the order *Polypodiaceæ*, and with the name *Gleicheneæ*. The species have the following characters:—Spore-cases dorsal with a transverse occasionally oblique ring, nearly sessile, and bursting lengthwise internally; the spores oblong or kidney-shaped. It includes the genera *Gleichenia*, *Mertensia*, *Sticherus*, *Platyzoma*, *Calymella*.

GLENOTREMITES (γλήνη, articular cavity, τρῆμα, a perforation), a genus of *Echinodermata*, with only one opening in the crust; established by Goldfuss, and by him compared to *Cidarites;* found in the chalk of Westphalia. ('Petrifacta Germaniæ.')

GLIRES, the fourth order of *Mammalia* in the 'Systema Naturæ' of Linnæus, who thus characterises it:—Incisors (dentes primores incisores) two above and below; Canines (laniarii) none. Feet unguiculate; progression salient (cursu salientes). Food obtained by gnawing the bark of trees, roots, vegetables, &c. This is the character given in the 'Synopsis' of the *Mammalia*. In the course of the work the dental formula is thus stated:—Incisors (dentes primores), two (bini) above and below, approximate, remote from the molars; no laniarii. The genera placed by Linnæus under this order in his last edition are, *Hystrix* (Porcupines), *Lepus* (Hares, Rabbits, &c.), *Castor* (Beavers, &c.), *Mus* (Rats and Mice, Guinea-Pigs, Agoutis, Marmots, Lemmings, Hamsters, Dormice, Jerboas, the Paca, &c., and the American Flying Squirrel (*Sciurus Americanus volans*, Ray), *Sciurus* (the Squirrels), and *Noctilio* (one of the Bats). [CHEIROPTERA RODENTIA.]

GLOBBA, a genus of Plants belonging to the natural order *Zingeberaceæ*, indigenous in the tropical parts of Asia, especially in the islands of the Indian Ocean and the continent of India, where they extend as far north as 30° along the forest-clad base of the Himalayan Mountains, and even ascend them to elevations of 2000 and 3000 feet; coming into flower in the rainy season. In a family abounding in highly ornamental plants, many of the species of *Globba* are likewise very showy; for the cultivation of which, in European latitudes, a climate and culture are required similar to that so successfully adopted for *Orchidaceæ*. The herbaceous parts yearly die down to the root-stocks; the leaves are distichous, lanceolate, with the sheaths split; inflorescence terminal, loosely panicled or racemose, flowers mostly yellow. In *Globba* is now included the genus *Mantisia*, which was so named from the resemblance of its flower to the Mantis insect; and the species *G. saltatoria*, commonly called Opera-Girls, from the supposed resemblance of the flowers to dancing figures. The fruit of *G uviformis* is said to be eatable.

GLOBE-FISH. [TETRODON.]

GLOBE-FLOWER. [TROLLIUS.]

GLOBIOCEPHALUS. [CETACEA.]

GLOBULARIA'CEÆ, *Selaginaceæ*, *Selagids* of Lindley, a very small natural order of Exogens, nearly allied to *Dipsaceæ*, *Asteraceæ*, *Verbenacea*, and *Myoporaceæ*. The species are herbaceous plants, or small branched herbs. The leaves are alternate, generally sessile, toothed or entire, without stipules, usually in clusters; flowers sessile, spiked with large bracts; calyx spathaceous, or tubular, persistent, with a definite number of teeth or divisions, rarely consisting of two sepals; corolla tubular, hypogynous, more or less irregular, with 5 lobes, imbricated in æstivation; stamens 4, usually didynamous, arising from the top of the tube of the corolla, seldom 2; anthers 1-celled, usually adnate to the dilated top of the filament, rarely versatile; ovary superior; style 1, filiform; stigma nearly capitate; ovules solitary, pendulous, anatropal disc hypogynous, fleshy; fruit 2-celled the cells either separable or inseparable, 1-seeded, membrauous; seed solitary, pendulous; embryo in the axis of a little fleshy albumen; radicle superior. The chief part of this order comes from the Cape of Good Hope. The species are of but little importance. Some are sweet scented. *Globularia Alyssum* is a bitter drastic purgative, once supposed to be the Αλύπον of Dioscorides, and hence called *Frutex terribilis*. *G. vulgaris* has similar properties. Both are emetic.

A twig of *Globularia longifolia*, in flower.

1, the calyx, corolla, and stamens in their natural position; 2, a corolla, separate, with the stamens and style; 3, the ovary enclosed in the calyx, half of which is cut away to expose it. All magnified.

GLOIOCLADIEÆ, a sub-order of Sea-Weeds belonging to the natural order *Cryptonemiaceæ*. The fronds are loosely gelatinous, the filaments of which they are composed lying apart from oue another, surrounded by a copious gelatine. The favellidia are immersed among the filaments of the periphery. It embraces the following genera:—

Cruoria.—Frond crustaceous, skiu-like.

Naccaria.—Frond filiform, solid, cellular; the ramuli only composed of radiating free filaments.

Gloiosiphonia.—Frond tubular, hollow, the walls of the tube composed of radiating filaments.

Nemaleon.—Frond filiform, solid, elastic, filamentous; the axis composed of closely packed filaments, the periphery of moniliform free filaments.

Dudresnaia.—Frond filiform, solid, gelatinous, filamentous, the axis composed of a net-work of anastomosing filaments; the periphery of moniliform free filaments.

Crouania.—Frond filiform, consisting of a pointed filament, whorled at the points, with minute multifid gelatinous ramuli.

(Harvey, *British Sea-Weeds.*)

GLOMERIDÆ, a sub-family of Insects belonging to the family *Chilopoda* and the order *Myriopoda*.

GLORIO'SA, a genus of Plants belonging to the natural order *Liliaceæ*, tribe *Tulipaceæ*, so named from the splendid appearance of its flowers. One species, *G. superba*, is indigenous in most parts of India, with a species, or variety, *G. simplex*, at moderate elevations on the Himalayas, while *G. virescens* is a native of Senegambia. The root is fleshy, the stem climbing, the leaves lanceolate, undulated, and terminating in a tendril serving to support the plaut. The six petals are undulated and reflexed, but pendent before flowering. The nearly horizontal stamens and declinate and oblique style give the flowers a very peculiar appearance, whilo their large size and the red and yellow colour of those of *G. superba* make it worthy of cultivation. This is successfully effected in hothouses. The fleshy root has a bitter and acrid disagreeable taste, and by some is said to be poisonous, but probably without sufficient foundation.

GLOSSOPETRA (γλῶσσα, a tongue, and πέτρα, rock), the name by which mauy early inquirers into the history of organic remains designated a great number of fossil teeth of fishes allied to the shark, which are found abundantly in the upper secondary and tertiary strata of England, France, Germany, Italy, &c. They were also called *Lamiodontes*, *Odontopetræ*, &c.

Amidst the difficulties which embarrassed the naturalists of the 16th century in their attempts to establish the true nature and origin of the organic remains of plants and animals found in the earth [GEOLOGY], the obvious resemblance between the fossil and recent teeth of fishes was a valuable and powerful argument. Fabio Colouna ('De Glossopetris Diss.,' 1627) and Agostino Scilla ('La vana Speculazione,' &c., 1670) pointed out the close agreement, in several cases, between the fossil teeth of Malta, Calabria, &c., and the teeth of living sharks; and the argumeut from similarity of form was made complete by considerations of the peculiar polish, hardness, chemical quality, and even colour of the fossil specimens. Scilla's figures are excellent. Ray, in a letter to Dr. Robinson (1684), makes the same use of the *Glossopetræ*.

"Some other bodies besides shells, commonly esteemed stones, there are found in the earth, resembling the teeth and other bones of fishes, which are so manifestly the very things they are thought only to resemble, that it seems to me great weakness in any man to deny it Such are the *Glossopetræ* dug up in Malta in such quantities that you may buy them by measure and not by tale; and also the vertebres of thorubacks or other cartilaginous fishes there found, and sold for stones, among the *Glossopetræ*, which have no greater dissimilitude to the teeth of a living shark, or the vertebres of a quick thornback, than lying so long in the earth, as they must needs have done, will necessarily induce. Now in this same Isle of Malta we found also many shell-like stones, which why we should not esteem to have been originally the shells of fishes I see no reason; for if in one aud tho same place we find many teeth and hones of fishes entire and unpetrified, aud likewise stones exactly imitatiug the shells of other fishes, a great presumption to me it is that these were originally the things whose shape only they now seem to bear. Neither are these *Glossopetræ* fouud only in Malta, but also iu many places of Germauy, far remote from the sea; in a hill near Aken, in so great plenty, that Goropius makes it an argument they could not be the teeth of sharks. 'In collo illo (saith he) qui Aquis-grano imminet, tantum id genus fuisse piscium quis crederet quantum de Glossopetrarum copiâ conjectari deberet?'"

Llwyd (1698), whose opinions on the real nature and origiu of organic fossils were turned in a wrong channel by the apparent impossibility of understanding how the various animal and vegetable exuviæ could be placed in their subterranean repositories by the Noachiau flood, a proposition which his judgment rejected, describes a considerable number of fish teeth according to the following method:—

Ichthyodontes cuspidati (considered to be incisor teeth of fishes Such of these as are triangular in figure (sagittati), flat with keen and often serrated edges, are called *Glossopetræ*.

Others which are more nearly round, elongated and pointed, he calls *Plectronitæ* (πλῆκτρον, a cock's spur).

Ichthyodontes scutellati (supposed to be molar teeth of fishes). Of these such as were round, umbonate, or scaphoid, were termed *Bufonitæ*.

The angular ones were called *Rhombiscus*.

The flattened pod-shaped teeth were called *Siliquastra*.

In Helwing's curious work, 'Lithographia Angerburgica' (1717), the state of knowledge on the subject in Germany appears little advanced, since he takes the trouble to reject the supposition that the *Glossopetræ* were serpents' tongues. He describes several species of sharks' teeth under the titles of *Glossopetra* and *Odontopetra*.

Until a very recent period there was little progress made in the study of the parts of fossil fishes beyond the views of Llwyd. Neither the *Glossopetræ* nor the *Bufonites* were at all better understood in England, till the successful researches of Mantell in Sussex reawakened the zeal of collectors; and Cuvier, besides renovating the whole subject of recent ichthyology, announced his intention of composing a systematic history of fossil fishes. The drawings which that great man had collected for the purpose were put into the hands of M. Agassiz, whose extraordinary zeal aud success have made a new era in fossil ichthyology. According to the views of this distinguished naturalist, all, or nearly all, the fish teeth known to the early collectors as *Glossopetræ* belong to the family of sharks, which must formerly have been more numerous aud included more various structures than the living races. The *Siliquastra* and other of the scutellate ichthyodontes of Llwyd are likewise teeth of sharks.

The following short synopsis may be convenient to collectors (see also Dr. Buckland's 'Bridgewater Treatise'):—

Family of Sharks.—Group 1, Cestracionts. (*Siliquastra*, *Rhombiscus*, &c. of Llwyd.) Teeth having a broad grinding surface.

2, Hybodonts. (*Plectronitæ* and *Glossopetræ* of Llwyd.) Teeth pointed, striated on both sides.

3, True Sharks. (*Glossopetræ* of Scilla, Llwyd, &c.) Teeth triangular, striated on one side only.

Many of the *Bufonitæ* of old writers belong to the extinct genera *Pycnodus* and *Gyrodus* of Agassiz; though they have often been compared to the teeth of *Anarrhicas lupus*, from which, according to Cuvier, they differ essentially in structure. ('Règne Animal.')

The geological distribution of these fish teeth is curious. Llwyd mentions that scutellate ichthyodontes had not occurred to him in the maritime regions of England, but were found not less plentifully than the cuspidate kinds iu the interior counties, as Oxford, Northampton, Gloucester, Berks, Bucks, &c. This is in agreement with conclusions of later date, for M. Agassiz has found that the whole group of Cestracionts is confiued to strata of the transition and secondary series; while only one of the race (*Cestracion Philippi*, or Port Jackson Shark), is now living.

Dr. Buckland ingeniously remarks, that "the greater strength and flattened condition of the teeth of the families of sharks that prevailed in the formations beneath the chalk had relation, most probably, to their office of crushing the hard coverings of the *Crustacea*, and of the bony enamelled scales of the fishes which formed their food." ('Bridgewater Treatise.')

GLOSSOPHAGA. [CHEIROPTERA.]

GLOSSOPORIS, a genus of Animals belonging to the order *Annelida*, and placed commonly near the Leeches. It has a posterior disc, but it is not suctorial.

GLOSSOPTERIS, a genus of Fossil Ferns, proposed by M. Adolphe Brongniart to include species whose elongated leaves or fronds are covered by fine arched dichotomous often anastomosing nervures. Examples occur in the Carboniferous and Oolitic systems of strata. [COAL-PLANTS.]

GLOTTALITE, a Mineral belonging to the group of *Zeolites*. It occurs crystallised; the crystals appear to be cubic and octohedral. Hardness 3·5. Brittle. Colour white. Lustre vitreous. Translucent. Specific gravity 2·181.

Before the blow-pipe it swells and melts into a white enamel. With carbonate of soda it gives an opaque white bead, and with borax a translucent glass.

It has been found near Port Glasgow, Scotland.

According to Dr. Thomson's analysis it yields :—

Silica	37·014
Alumina	16·308
Lime	23·927
Peroxide of Iron	0·500
Water	21·250
	98·999

GLOTTIS. [LARYNX.]

GLOW-WORM. [LAMPYRIS.]

GLUMACEOUS PLANTS are what are more commonly called *Graminaceæ* and *Cyperaceæ*, to which *Juncaceæ* and a few other orders are occasionally added. They derive their name from the flowers consisting of glumes only.

GLUMALES. [ENDOGENS.]

GLUMIFERÆ, a subdivision of Endogenous Plants, embracing the orders with glumaceous flowers, *Cyperaceæ* and *Graminaceæ*. [CYPERACEÆ; GRAMINACEÆ.]

GLUTTON, the vernacular name for the *Wolverene*. [GULO.]

GLYCE'RIA (from γλυκερός, sweet), a genus of Plants belonging to the natural order *Graminaceæ* and the tribe *Festucineæ*. It has unequal acute sub-membranous glumes, the outer palea with 5-7 strong prominent distinct and parallel ribs, and a scarious margin, subcylindrical, unarmed; the styles terminal. The species are handsome grasses with long stems, and mostly inhabit watery places. The following are the British species of this genus :—

G. aquatica has an erect panicle, repeatedly branched and spreading, rachis semiterete, branches scabrous; spikelets linear, oblong, of 5-10 flowers, outer pale, obtuse; leaves smooth, with slightly compressed sheaths. The root is creeping; stem three to six feet high, smooth, and slightly compressed; sheaths very long; leaves long, rough on the edges and keel; ligule short; panicle large. Branches angular, slender, branched; outer pale, with the central nerve extending to the summit.

G. fluitans has a second panicle, slightly branched, very long; branches nearly simple, roughish; spikelets linear, of 7-12; adpressed lanceolate oblong acute flowers, outer pale, nearly thrice as long as broad; sheaths compressed; stem ascending, rooting below or floating; sheaths nearly smooth, striated; leaves pale green, acute; ligule elongate; panicle remarkably elongated, often nearly simple. Branches without callosities, ascending, lowermost in pairs; spikelets adpressed; outer pale, rather shorter than the inner, with a triangular central point; anthers about five times as long as broad, purple, pale yellow when empty.

G. plicata has a compound panicle; branches compound, nearly smooth, erect when in flower, divaricate with fruit; spikelets linear, of 7-20; oval-oblong rather acute flowers, outer pale, twice as long as broad, sheaths compressed. The sheaths are rough and furrowed. Leaves glaucose, bluntish, plicate when young; ligule shorter; panicle much branched; branches with callosities at the base, lowermost about in fives; outer pale, with three teeth at the end; anther about three times as long as broad, cream-coloured, fuscous when empty. (Babington, *Manual of British Botany*.)

GLYCERINE. [ADIPOSE TISSUE.]

GLYCERIS, a genus of Dorsibranchiate Annelids. It is distinguished by the form of its head, which terminates in a conical fleshy horn-like point, which is divided at the top into four very small tentacles.

GLYCINE. [WISTARIA.]

GLYCYMERIS. [PYLORIDIANS.]

GLYCYRRHI'ZA, a genus of Plants belonging to the natural order *Fabaceæ*, or *Leguminosæ*, consisting of herbaceous plants with pinnated leaves, small flowers in axillary spikes, and roots running very much in the soil in which they grow. The technical character of the genus is given by De Candolle thus :—"Calyx naked, tubular, 5-cleft, bilabiate; the two upper lobes grow together beyond the others. Standard ovate-lanceolate, straight; keel 2-headed or 2 petalled, straight, acute. Stamens diadelphous. Style filiform. Legume ovate or oblong, compressed, 1-celled, 1-4-seeded."

G. glabra, the common Smooth Liquorice, has ovate rather retuse leaflets, somewhat clammy beneath, as well as the branches; stipules wanting; spikes or racemes of flowers pedunculate, shorter than the leaves; flowers distant; legumes glabrous, 3- or 4-seeded. It is a native of the south of Europe from Spain to Tauria, also of China, and is cultivated in France, Italy, Germany, and England for the sake of its roots. The flowers are of a pale blue colour. The name Liquorice, according to Du Theis, is said to be a corruption of the French word 'reglisse,' which is itself a corruption of *Glycyrhiza*. The roots abound in a saccharine mucilaginous matter, which is slightly bitter, and readily soluble in water. A powder, and the well-known common extract, are prepared from it. The decoction in different forms is a common remedy for coughs.

Common Smooth Liquorice (*Glycyrhiza glabra*).

The Common Liquorice-Plant is cultivated in many parts of England, especially about Pontefract, whence the name of Pomfret cakes, applied to a fine preparation of liquorice. Though commonly grown in the field it requires very superior culture in order to produce fine roots for sale in the market. The soil in which it delights to grow is rich black mould, but where this cannot be procured a fresh loam will answer the purpose, provided there is not much wet clay in its composition. It must be at least three feet deep to allow a free passage for the roots, as they are generally expected to be a yard in length, and as the straight ones are more highly prized than those which are crooked. On this account the spade is more useful than the plough in cultivating the ground, and though at first it may be expensive, yet the husbandman will in the end be well repaid for his trouble.

After the ground is fixed upon it must be well covered with good rotten dung, trenched three feet in depth, and left in this state during the winter to be mellowed by frost. About March, if the weather is fine, the plantation should be formed. Plants are either raised from seeds or, as is more commonly the case, from a division of the old roots, which are cut into pieces eight or ten inches long. Choice should be made of those which, as planters term it, have good eyes, that is, buds, and which are more likely to push and grow strong.

A garden line must then be set for the first row, and holes made with the setting stick about a foot and a half apart; into which the sets must be dropped and covered about two inches with soil. The rows must be at least three feet apart, and the plants in one row should be alternate with those of the other; this will not only give them more room, but will have a neat appearance, forming regular rows from whatever part the field is viewed.

"For the first year," says Abercromby, "you may cultivate a light crop of lettuce or onions between the rows. During summer keep the ground free from weeds, and when the subordinate crop comes off hoe and dress the ground. At the close of autumn, or as a winter dressing, fork or dig between the rows to stir and refresh the surface; and cut down the decayed stems. After three or four years' growth the main roots will be of a mature size, and fit for consumption or the market. It is an excellent plan to cover the crowns of the plants in winter with good rotten dung, as it not only preserves them from severe frosts, but is washed down by the rain and becomes valuable nourishment to the roots."

G. echinata has oval lanceolate leaflets, mucronate, glabrous; stipules oblong, lanceolate; spikes of flowers capitate, on very short peduncles; legumes oval, mucronate, 2-seeded, echinated by bristles. It is native of Apulia, on Mount Gardano, and in the northern provinces of China and of Tartary. The whole plant is glutinous to the touch. The roots are horizontal, in taste like the Common Liquorice.

(Don, *Dichlamydeous Plants*; Lindley, *Flora Medica*.)

GLY'PHIS, a genus of Fossil Placoid Fishes from the London Clay. (Agassiz.)

GLYPHISODON, a genus of Acanthopterygious Fishes belonging to the family *Sciænidæ*. The gill-covers are entire, and they have a single row of trenchant and sometimes notched teeth. The species are found in the Atlantic, but are more abundant in the Indian Seas.

GLYPTOCE'PHALUS, a genus of Fossil Cycloid Fishes from the London Clay. (Agassiz.)

GLYPTODON (Owen, so named from the fluted character of its teeth), a genus of extinct Fossil Animals belonging to the order *Edentata*, and allied in form and structure to the modern Armadillos. The first notice of the discovery of the remains of the skeleton of a large edentate animal, with fragments of a tesselated bony armour, similar to that of the Armadillo, appears in the note appended to the end of Cuvier's chapter on the *Megatherium*, in the 4th edition of the 'Ossemens Fossiles,' published in 1823. This notice occurs in an extract from a letter addressed by D. Daniasio Larranaga, curé of Monte Video, to M. Auguste St.-Hilaire. The facts stated in this letter are as follows:—A femur was discovered in the Rio del Lance, branche du Saulis Grande, which weighed 7 lbs.; it was short, but might be from 6 to 8 inches in width; it resembled in every respect the femur of an Armadillo; with it was found a portion of tesselated bony armour, of which the curé promises to send one of the component pieces to M. Auguste Geoffroi. The tail was very short and very stout; it had in like manner a bony armour, but this was not verticillate or disposed in rings. These fossils were stated to have been met with near the surface of the earth, in alluvium or strata of transport, indicative of a very recent epoch. Similar fossils are said to occur in analogous strata near the Lake Nirum, on the frontier of the Portuguese colonies.

These remains were supposed to belong to the *Megatherium*, and Cuvier does not appear to suspect that they belonged to anything else, as he merely remarks that the *Megatherium* had pushed its analogies with the Armadillos so far as to be covered like them with a scaly cuirass.

Subsequently remains of this kind were sent to England, and in the meantime M. Laurillaud and Mr. Pentland, on comparing these with those originally sent to England, came to the conclusion that they belonged to the genus *Dasypus*. This however was doubted by Mr. Clift and Professor Owen, seeing that the conformation of the alveoli of the jaw indicated a dentition differing more widely from that of the existing sub-genera of Armadillos than their respective dental characters differ from one another. "It was at this conjuncture," says Professor Owen, "that Sir Woodbine Parish received the intelligence of the discovery of an entire skeleton, covered with its tesselated coat of mail, about 5 feet below the surface, in the bank of a rivulet near the Rio Matanza, about 20 miles south of the city of Buenos Ayres; and with the account of this remarkable discovery there was at the same time transmitted a drawing or sketch of the whole animal, which has since been lithographed, and one of the teeth of the fossil itself. This tooth Sir Woodbine Parish obligingly submitted to my examination. Its general structure proved it to belong to an animal referrible to the *Edentata* of Cuvier; but its character was so peculiar that I had no hesitation in pronouncing it to differ from that of any known edentate animal, recent or fossil, and from its intimate texture, to be indicative of a new sub-genus of the Armadillo family, for which I proposed the name of *Glyptodon*, in reference to the plated or sculptured character of the tooth."

The *Glyptodon* differs from the *Megatherium* not only in the form and structure but in the number of its teeth, which appear to be eight on each side of each jaw, as in the section of Armadillos called *Cabassous* by Cuvier. It differs from the Armadillos in the form of the lower jaw, and in the presence of a long process descending from the zygoma, in both which respects it resembles, and evidently indicates a transition to the *Megatherium*.

Numerous remains of this curious and interesting animal have been found in various parts of the country, and a very fine specimen, with the coat of mail almost entire, is to be seen in the museum of the College of Surgeons. Portions of this animal are also to be seen in the collection of the British Museum.

Although, when the remains of the *Glyptodon* were first brought to Europe, it was not thought improbable that the *Megatherium* also was inclosed in a gigantic suit of armour, no remains that could be regarded as the tesseræ of such a covering have yet been discovered. It is always difficult however to establish a negative, but the following arguments have been adduced by Professor Owen against this supposition, and will be probably regarded by most naturalists as conclusive:—

"1. The opinion of Cuvier and Weiss, in favour of the *Megatherium* being so armed, rests on no better ground than the mere fact of bony armour of some gigantic quadruped and the skeleton of the *Megatherium* having been discovered on the same continent.

"2. The skeleton, or its parts which have been actually associated with the bony armour above mentioned, belongs to a different and smaller quadruped.

"3. No part of the skeleton of the *Megatherium* presents those modifications which are related to the support of a bony dermal covering.

"4. The proportions of the component tesseræ of the bony armour in question to the skeleton of the *Glyptodon*, are the same as those between the dermal tesseræ and skeleton of existing Armadillos, but are vastly smaller as compared with the bones of the *Megatherium*.

"5. No bony armour composed of tesseræ, having the same relative size to the bones of the skeleton of the *Megatherium*, as in the *Glyptodon* and existing Armadillos, has yet been discovered.

"6. The skeleton of the *Megatherium* has never been found associated with bony armour of any kind, neither have its parts been found associated."

(Owen, *Proceedings of Geological Society*, vol. vii., 2nd series.)

GLYPTO'STEUS, a genus of Fossil Ganoid Fishes, from the Old Red-Sandstone of Elgin and Clashbennie (Agassiz): two British species.

GMELI'NA, an Asiatic genus of Plants named after Gmelin, the author of 'Flora Sibirica,' belonging to the natural order *Verbenaceæ*, of which only one species was formerly known, but five are described by Dr. Roxburgh, and a sixth (with some doubtful species) noticed by Dr. Wallich, in his 'Indian Catalogue.'

The genus is characterised by having a small 4- sometimes 5-toothed calyx, the corolla large, obliquely campanulate, the border irregularly 4-parted, something like those of foxglove in shape, but mostly yellow in colour. Stamens 4, didynamous, with the anthers 2-cleft. Germ superior, 4-celled; cells 1-seeded; attachment sub-superior. Drupe with a nut, from 1- to 4-celled. Embryo erect, without perisperm. All the species of *Gmelina* form shrubs or trees, of which the latter are valued for their timber. They are found in the islands of the Indian Ocean, extending thence into the Malayan and Indian peninsulas. *G. Asiatica* and *G. parvifolia* are common in various parts of India, and *G. arborea* extends from Prome and Martaban even to the Deyra Valley, in 30° N. lat.

The leaves of *G. parvifolia* are remarkable for rendering water very mucilaginous, and are employed medicinally in India; but *G. arborea* (Goombar and Koomhar of the natives) appears to be the most valuable for its timber, as, besides being spread over a wide extent of territory, it attains great size. Dr. Roxburgh mentions it squaring into logs of from 18 to 24 inches, which are occasionally nearly 30 feet long. The wood resembles teak, the colour being the same; the grain rather closer, but it is somewhat lighter. It seems particularly valuable for situations where it is exposed to both the influence of air and of water. One experiment was made by placing part of an outside plank in the river Hoogly, a few miles below Calcutta, "a little above low-water mark, exactly where the worm is thought to exert its greatest powers." Dr. Roxburgh states, that "after remaining three years in this situation, though examined from time to time, the piece was cut, with the view of carrying a specimen of it to England; and to my great joy, I found it as sound and every way as perfect throughout as it was when first put into the river." ('Fl. Ind.,' iii. p. 85.) In another experiment this wood remained good for seven years, while teak, similarly placed, required to be replaced after six years. Hence Dr. Roxburgh suggests experiments on and employment of this wood in ship-building.

GMELINITE, or HYDROLITE, a Mineral belonging to the group of *Zeolites*. It occurs crystallised. Its primary form is a rhomboid; usual form an hexagonal prism; cleavage parallel to the primary planes. Fracture uneven. Hardness 4·5. The colour white, passing into flesh-red; streak white; lustre vitreous; translucent. Specific gravity 2·05.

Before the blow-pipe it increases in bulk, and assumes the appearance of an enamel, but does not melt into a glass. It is found in the Vicentine; at Glenarm, county of Antrim, in cavities in amygdaloidal rocks; and also in North America. [CHABAZITE.]

The following is an analysis by Connell from Glenarm:—

Silica	48·56
Alumina	18·05
Lime	5·13
Soda	3·85
Potash	0·39
Peroxide of Iron	0·11
Water	21·66
	97·75

GNAPHA'LIUM (from γνάφαλον, which signifies the wool which the fuller cuts off in fulling the cloth), a genus of Plants belonging to the natural order *Compositæ*, to the sub-order *Corymbiferæ*, the tribe *Senecionideæ*, the sub-tribe *Gnaphalieæ*, the division *Helichryseæ*. It has the ray-florets pistilliferous, the centre with both stamens and pistils, all of them tubular; the pappus capillary; the receptacle flat, naked; the involucre hemispherical, imbricated; the scales equalling the florets, but not mixed with them. The corolla of the outer florets is often obsolete. The species of this genus have a soft pubescent foliage with dry flowers, which keep for a long time without perishing, and like those of some species of *Helichrysum* and *Xeranthemum*, are called 'everlastings' or 'immortal' flowers. The species are numerous. Five are British. Of these *G. uliginosum* is the most common, growing in wet and sandy places. *G. luteo-album*, *G. sylvaticum*, *G. supinum*, and *G. pusillum* are all rare plants. Several of the species of the old genus *Gnaphalium* are referred to new genera as *Antennaria* and *Filago*. *G. dioicum* is *Antennaria dioica* of Gærtner. It grows on mountain heaths in Great Britain, and is commonly called Cotton-Weed, and by the older herbalists Pes Cati. Its flowers were admitted into the older pharmacopœias under the name of 'Flores hispiduli Pes Cati.' They are astringent, and were employed in the cure of hooping-cough, phthisis, and hæmoptysis. *G. arenarium* (*Helichrysum arenarium*) has been employed as a remedy in dyspnœa. *G. Stœchas* of Linnæus, Goldilocks, the *Helichrysum Stœchas*, is mentioned by Theophrastus ('Hist. Pl.' 9, 21). The flowers of this plant were formerly much used in medicine, but are seldom employed at the present day.

(Babington, *Manual of British Botany;* Burnett, *Outlines of Botany;* Fraas, *Synopsis Plant. Fl. Classicæ.*)

GNAT. [CULICIDES.]

GNA'THODON, a genus of Conchiferous *Mollusca* with the ligament inclosed in the cartilage pit, established by Dr. Gray. This peculiarity of structure is also found in a new genus *Mulinia*.

GNATHO'STOMA (γνάθος, a jaw, and στόμα, the mouth), a genus of Nematoid *Entozoa* [ENTOZOA], discovered by Professor Owen in the stomach of the tiger. These worms, the largest of which are about an inch in length and a line in diameter, were found in the substance of several small cellular tumours situated immediately beneath the mucous membrane of the stomach, and apparently formed by the condensation and thickening of the submucous cellular tissue, which was probably owing to the irritation of the *Entozoa*. Only a pair of these animals was found in each tumour, and they always consisted of male and female, the former of which was about one-fourth smaller than the latter.

In both sexes the body is round, elastic, and attenuated at both extremities; the tail is more obtuse and bent in the male; the head is obtuse and truncated in both of them. The integuments are transparent, and, from the intestinal and genital tubes showing through the surface of the body, appear to be striated transversely. The anterior two-thirds of the body are covered with a circular series of minute reflected spines, each furnished with three points. The mouth is surrounded by a tumid circular lip, and armed with several rows of spinous processes of a similar structure to those on the body. The orifice of the mouth itself is bounded on each side by a jaw-like process (whence the name of the genus), the anterior margin of which is formed into three straight horny points, or processes, directed forwards. The male organ of generation consists of a slightly-curved slender spiculum, not furnished with a sheath as in the *Strongylus*, and surrounded by eight distinct pointed papillæ.

The most interesting point in the internal structure of this entozoon, and which does not appear to have been hitherto detected in any other animal of this class, is the existence of a distinct salivary apparatus, similar to what is found in the *Holothuria* and other *Echinodermata*. "This apparatus," says Professor Owen, "consists of four elongated straight blind tubes, each about two lines in length, which are placed at equal distances around the commencement of the alimentary canal, having their smaller extremities directed forwards, and opening into the mouth, and their closed obtuse ends passing backwards into the abdominal cavity. When examined with a lens of a quarter of an inch focus, the parietes of these salivary tubes present very distinct oblique or spiral decussating fibres; their contents are semi-pellucid in the recent worm, but become opaque in spirit of wine." The existence of this salivary apparatus along with the more perfect organs of mastication, as the jaws, in this entozoon is highly interesting, as it shows an approximation to the structure of the digestive organs in the higher classes of animals.

Professor Owen has since found the *Gnathostoma* in the stomach of other animals of the Cat kind, as the leopard.

Beautiful preparations of both the male and female worms dissected are preserved in the museum of the College of Surgeons in London.

GNEISS, a German term for the lowest series of stratified primary rocks, the introduction of which marks the obligations which British geologists owe to the school of Werner; while such terms as lias, cornbrash, gault, &c., record the original discoveries of Smith and other English writers. As there are no organic remains in the gneiss strata, and the variations of its composition and structure appear independent of the relative antiquity of the deposits, it is impossible, except by the help of the included limestones, quartz-rocks, clay-slates, &c., even to attempt the division into formations of the vast thickness of the gneiss strata which appears in the Highlands of Scotland, the mountains of Scandinavia, &c.

Gneiss is generally a compound of the same three minerals as granite, namely, quartz, felspar, and mica. In the same manner as granite varies in the proportion of its ingredients, the magnitude of the component crystals, the absence of mica, or the substitution of other minerals for it, so gneiss exhibits corresponding variations.

Dr. M'Culloch, whose examination of the gneiss tracts of Scotland was very complete, presents an extended synopsis of the varieties of gneiss which he had observed. His table includes indeed a great number of mineral compounds different from the general character of gneiss, but is nevertheless valuable to the geologist. He considers gneiss in three divisions: first, of regular composition, containing at least three of the four minerals—quartz, felspar, mica, and hornblende; secondly, of irregular composition, containing compact felspar; and thirdly, of irregular composition in other respects. ('Treatise on Rocks.')

The following is a synopsis of the first division:—

Granitic Gneiss.—This is always large grained.
- *a.* Composed of quartz, felspar, and mica.
- *b.* Composed of quartz, felspar, and hornblende.
- *c.* Composed of quartz, felspar, mica, and hornblende.

Schistose Gneiss.—The structure is foliated like mica-schist, or granular like quartz-rock.
- *a.* Composed of white felspar and quartz in minute grains with rare scales of mica (resembles quartz-rock).
- *b.* Composed of felspar and quartz as above, but with abundance of mica (so as to resemble mica-schist).
- *c.* In this the mica is extremely abundant, so as to form continuous laminæ.
- *d.* In this the mica is predominant, and there are large interspersed crystals of felspar.
- *e.* Composed of large grains of quartz and felspar with little mica.

Laminar Gneiss.—Each substance occupying a distinct lamina.
- *a.* Composed of quartz and felspar.
- *b.* Composed of quartz, felspar, and mica.
- *c.* Composed of quartz, felspar, and hornblende.
- *d.* Composed of felspar and hornblende.
- *e.* Composed of quartz, mica, and hornblende.

All the varieties of rock comprised under the title of gneiss are stratified, the beds varying much in thickness, and being most remarkably subject to contortions both on a large and small scale, especially where granite veins cross the laminæ.

Gneiss is an interesting rock for study to the English geologist. Over a considerable portion of the mainland, and in the western islands of Scotland, gneiss is the predominant and fundamental rock. It is also found abundantly in Ireland. The picturesque features of gneiss present almost every imaginable variety, a broad expanse occupied by this rock sometimes extending over considerable tracts, and being only relieved in its savage monotony by occasional pools of water or patches of bog; while in other districts it forms wild and rugged hills, assuming a mountainous character, and displaying broken and craggy faces of rock. (Ansted.)

Gneiss admits of considerable variety by the substitution of other minerals for either the quartz, felspar, or mica of which it is usually composed. The mica, for instance, may be replaced by talc, forming what is called Stratified Protogine. In some cases hornblende is superadded to the ordinary materials, forming a syenitic gneiss.

GNETA'CEÆ, *Joint-Firs*, a natural order of Plants belonging to the small class of Gymnosperms. The species consist of small trees very much branched, or of sarmentose shrubs with opposite or clustered branches, and thickened separable articulations. The leaves are opposite, entire, with pinnate veins, sometimes very minute and scale-shaped. The ligneous tissue of the wood is marked with circular discs. The flowers are monœcious or diœcious; the stamens are contained in a 1-leaved calyx; the ovary is perforated at the apex, containing in a single cavity a solitary erect ovule; the ovule pointed by a stylo-like process, formed from the membrane of the nucleus; there is no trace of a style or stigma.

This small order of plants has been formed by Blume, whose memoir in the 'Annales des Sciences Naturelles' contains the principal knowledge we have of this order. "This little family," he says, "constitutes a part of that natural class of vegetables in which the fertilisation of the ovule takes place immediately, without the aid of style or stigma, through the foramen of the ovule itself. Through *Ephedra*, which has hitherto been placed with *Coniferæ*, the order is closely connected with the latter: and, on the other hand, it tends towards *Casuarinaceæ*, plants of a higher degree of organisation; since *Gnetaceæ* is beyond all doubt an instance of a more perfect kind of evolution than either *Coniferæ* or *Cycadaceæ*. From both these orders *Gnetaceæ* differ in the greater perfection of their sexual organs, especially of their stamens; and at the same time their ovules are not absolutely naked, but covered with a pericarpial integument pierced at the summit. In the male flowers the perianth is tubular; at first quite closed up, in the manner of certain *Artocarpeæ*, but eventually it is ruptured by the rising of the stamen. There is no trace of a perianth of this sort in the neighbouring orders; but in *Coniferæ* a totally different organisation of anther occurs, that part not opening, as in *Gnetaceæ*, by transverse pores of the apex, but always at the side, and generally longitudinally."

The species of this family are natives of the temperate parts of Europe, Asia, and South America. *Gnetum* is an inhabitant of the hottest parts of India and Guyana.

Some of the species of *Gnetum* are used as food. The seeds of *G. Gnetum* are eaten in Amboyna, and are roasted, boiled, or fried. The green leaves are cooked and eaten like spinach. The inside of the fruit of *G. urens* is lined with stinging hairs; the seeds are, however, eaten; the stem exudes a transparent gum, and when cut across yields a large quantity of transparent water, which is drunk.

(Lindley, *Natural System of Botany*.)

GNU. [ANTILOPEÆ.]

GOAT. [CAPREÆ.]

GOAT'S-BEARD. [TRAGOPOGON.]

GOAT-MOTH. [COSSUS.]

GOAT-PEPPER. [CAPSICUM.]

GOAT-SUCKERS, the English name of those Night-Swallows commonly termed Night-Jars; whence the name *Caprimulgidæ*, by which the family is generally known among ornithologists. Mr. Rennie changes the name of the European Night-Jar to *Nyctichelidon* (Night-Swallow), objecting that the name Goat-Sucker, which it has received in all languages, and which, he thinks, has been most absurdly continued by systematic naturalists in the term *Caprimulgus*, shows the opinion of it entertained by the vulgar. Now we cannot admit this great absurdity, though we entirely agree with Mr. Rennie that "it is as impossible for the night-jar to suck the teats of cattle (though most birds are fond of milk), as it is for cats to suck the breath from sleeping infants, of which they are popularly accused." If every zoological name that has not a sure foundation were to be changed, there would be no small alteration in nomenclature and not a little confusion; as it is, the perpetual change of names is quite sufficiently perplexing. Nor are we at all sure that such names as *Caprimulgus* are not of some value as showing, in connection with a true history of the habits of the bird, how the errors and superstitions of old times have vanished before the light of modern investigation. Thus much as an apology for not changing the family name *Caprimulgidæ*.

Mr. Vigors remarks that when we search among the Perchers for that point where they approximate the Owls, we at once light upon a group, the *Caprimulgus* of Linnæus, whose general appearance and habits point out the affinity. "The nocturnal and predatory manners of this genus," says Mr. Vigors, "the hawking flight, the legs feathered to the talons, the large ears and eyes, the very disc that surrounds the face, and the pectination of the external quill-feathers, observable in some of the species, the general softness of the plumage, together with its peculiarly striking colour and markings, produce a similarity between it and the *Strix* that has attracted the eye of the common observer no less than the naturalist. The provincial names of this genus have generally a reference to this resemblance; while the earlier scientific describers of the different species have for the most part ranked them with the owls. I know not whether the singular character observable in some of the species of this family, the serrated nail of the middle toe, may not be cited as an additional proof of their approach to the birds of prey. The strong toes of the latter are lost in *Caprimulgus*: but a construction of similar import (for the serration of the nail appears capable of being applied to the purposes of seizure only), preserves, though faintly, the resemblance. May we not almost venture to affirm that this apparently trivial appendage is an instance of that beautiful shading by which nature softens down the extremes of her neighbouring groups —one of those minute and delicate touches by which she marks at once an affinity and a deviation? But while we may discern at a glance the general approximation of these two families, we must at the same time acknowledge that they stand in need of an intermediate link to give them a closer connection. The weakness of the bill and of the legs and feet of the *Caprimulgus* still keeps it at some distance from the owls, in which the same members are comparatively strong; while the wide gape of its mouth serves to divide the families still further. A connecting link has been however supplied by an Australian group, the *Podargus* of M. Cuvier, which harmonises these discrepant characters. We have an opportunity of observing among the specimens in the collection of the Linnean Society, how far the bill of this extraordinary genus combines the different forms of that of the two genera, and how far the legs, still maintaining the characteristics of *Caprimulgus*, such as the unequal length of the toes, are related to those of *Strix* by their superior robustness. Here indeed there is a beautiful gradation of affinities. All the front toes of *Caprimulgus* are united by a connecting membrane as far as to the first joint; those of *Strix* are divided to the origin; while those of *Podargus* partake of the characters of both, in having the middle toe connected with the outer, but divided from the inner. Again, as I have already remarked, *Caprimulgus* has the nail of the middle toe dilated and serrated: *Strix* has it, generally speaking, undulated and entire at the margin; but in *Podargus* the same part displays the singular dilatation of the one and the marginal integrity of the other It is difficult to say to which of these groups it comes nearest, until further and more accurate accounts than we at present possess of its food and economy may determine its actual situation. At present it remains oscillant between the two families, and may decidedly be pronounced the immediate passage from the birds of prey to the perchers." Mr. Vigors adds in a note that he had latterly obtained accounts from actual observers of some of these *Podargi* in Australia stating their manners to be generally conformable to those of th *Caprimulgi*.

Mr. Vigors further observes that the union between the two families of *Caprimulgidæ* and *Hirundinidæ* in the most essential particulars, in the habits, economy, and general conformation, is too evident to the common observer, and too universally acknowledged by scientific writers, to need any further illustration. But he remarks that it is gratifying to observe how, even in minute particulars, a gradual succession of affinities imperceptibly smooths the passage between conterminous groups; nor does he pass over without remark the circumstance of the hind toe of *Caprimulgus* being usually retractile, which enables it to place all its toes in front, in a similar position to that which they maintain in *Cypselus*, where the family of the *Hirundinidæ* terminates. He notices also the conformation of the tail in the two families as showing a similar affinity, observing that some species of *Caprimulgus*, then lately arrived from Brazil, exhibit the forked tail of *Hirundo*, one of which, indeed, the *C. psalurus* of Temminck, has this character developed to an almost disproportionate degree. "Leaving those typical families," continues Mr. Vigors, "with the short bill, and taking a general survey of the tribe, we may perceive that the *Caprimulgidæ* unite themselves to the longer-billed families, by means of the Linnean *Todi*, which preserve the broad base of the bill of the latter, but lead on, by comparative length of that member, to the succeeding family of *Halcyonidæ*. If we compare the bill of the type of the last-mentioned genus, the *Todus viridis*, Linn. [MUSCICAPIDÆ], with those of *Caprimulgus* and *Halcyon* [KINGFISHERS], we shall perceive that it stands exactly midway between them in the relative proportions of strength and breadth which it bears to each. In the length also of the tail, an important character in the groups that feed on the wing, it maintains a middle station between them." For the group which forms the immediate connection between the present family of *Todidæ* and the preceding *Caprimulgidæ*, Mr. Vigors observes that we are indebted to Dr. Horsfield, since in the depressed and broad-based bill and wide gape of *Eurylaimus* we recognise the characters which unite those families [MUSCICAPIDÆ], and Mr. Vigors refers to the valuable plates of the 'Zoological Researches in Java' as exhibiting the intimate approach of the bill of this latter genus to that of *Podargus Javanensis*. Near to *Eurylaimus*, which in the opinion of Mr. Vigors is united to *Todus* by some species now referred to the former genus, but which were originally included in the latter, he would place the genus *Eurystomus* of Vieillot [MEROPIDÆ], which in the essential characters of the bill, and from all Mr. Vigors could ascertain of its general habits and economy, seems to him to bear a striking affinity to the present group. Here also the same considerations would incline him to arrange the *Calyptomena* of Sir Stamford Raffles, which differs chiefly from the groups now mentioned in its comparatively shorter bill and the singular covering of plumes that project over the upper mandible. All these and some other corresponding genera will be found, Mr. Vigors makes no doubt, on more accurate knowledge of their economy, to belong either to the present family, which is placed at the extremity of the *Fissirostres*, or to that of *Pipridæ*, which forms, in the system of Mr. Vigors, one of the aberrant groups also of the neighbouring circle of *Dentirostres*, and thus comes in contact with the *Todidæ*. Mr. Vigors admits that more extensive knowledge respecting these birds will determine the line of demarcation between them; but the general affinity by which they approach each other, at least, in continuous families, may at once, in his opinion, be decided without hesitation. ('On the Natural Affinities that connect the Orders and Families of Birds,' 'Linn. Trans.,' vol. xv.)

Mr. Swainson ('Classification of Birds') considers the order of *Fissirostres* to be best represented by the Swallows and Goat-Suckers; observing at the same time that the former are the most isolated, whilst the latter, above all other birds, show the nearest affinity to the Owls. "No species indeed," says Mr. Swainson, "has been yet discovered which would perplex a naturalist to decide to which of these families it belonged, but that is not material; we do not uphold the injudicious theory that every one of nature's links is so perfect, or rather so well known, as to leave no unequal intervals in the series; on the contrary, we maintain that such interruptions are frequently found, and in this manner are the Goat-Suckers detached by a slight interval from the Owls." The same author remarks that the Fissirostral Birds, as a whole, are peculiarly distinguished by having the powers of flight developed in the highest degree; all the energies of their nature, he observes, seem concentrated in this one perfection; for their feet are always very short, weak, and generally so imperfect as to be of use only to rest the body after flight; their food being exclusively insects captured upon the wing. "To accomplish this," proceeds Mr. Swainson "nature has given to their mouth an enormous width, by which, superadded to their amazing flight and rapidity of movement, they are almost sure to capture their prey. Who that has watched the swallow or the goat-sucker has failed to recognise these peculiar perfections? As the nocturnal goat-suckers frequently prey upon beetles and large moths, the mouth, in such species, is defended by stiff bristles; but these appendages are rendered unnecessary to the swallows; their game consisting entirely of those little soft insects seen in the air on a summer's evening or sporting on the flowers of a sunny field. The goat-suckers choose the twilight, and catch their food precisely in the same way, excepting, indeed, that their little short feet are sometimes used for the same purpose, a most singular part of their economy, first noticed by our countryman White. Some of these nocturnal birds (*Poyardus*,* Cuv.) have a bill nearly as strong as an owl's; others are furnished with forked tails of excessive length; and one species, discovered during our researches in Brazil (*Caprimulgus diurnus*, Temm.) quits the nocturnal habits of its congeners, and in cloudy days may be seen in troops of 15 or 20 skimming over the surface of ponds, precisely in the manner of swallows." Mr. Swainson then remarks that the Swallows and the Goat-Suckers are, in fact, connected by certain swifts, for the Balassian Swift is described as a nocturnal bird, appearing at sunset and going to rest at sunrise; and thus he enters the family *Hirundinidæ*. [HIRUNDINIDÆ.]

The *Caprimulgidæ*, according to Mr. Swainson's classification, consist of the following genera and sub-genera. But it should be remembered that he states that he has thought it best not to attempt a natural arrangement until the family is better understood.

The following are the characters of the family:—Plumage lax, soft. Bill exceedingly small; gape enormous; feet very short, weak; the hallux directed forwards. (Swainson.)

Podargus, Cuvier.—Size large; the middle claw not serrated; the hallux not directed forward.

Sub-genera, *Podargus* proper.—Bill large, very strong, the tip and margins of the upper mandible folding over those of the lower; culmen elevated and arched; true rictal bristles none; tongue very thin, entire; tarsus short. (Swainson.)

Several species of this sub-genus have been found in Australia, and we select as an example of these—

P. humeralis.—It is variegated above with ashy brown and dirty yellow; head and sides of the back conspicuously striped with black; forehead and dorsal plumage lightly dotted and banded with white; tesselated beneath with black stripes and approximating dirty yellow bands. Length of the body 20 inches, and of the tail 8½ inches.

Cold-River Goat-Sucker (*Podargus humeralis*).

Mr. Vigors and Dr. Horsfield observe that the birds of this genus in the collection of the Linnæan Society bear such a general resemblance to each other, that they felt some hesitation in describing them as different species. The careful examination of many individuals in their own country will, in the opinion of these zoologists, alone determine with certainty whether they are distinct or merely varieties of the same species from age or sex. They state however that Dr. Latham, as well as themselves, distinguished this as a species under the name of the Cold-River Goat-Sucker from the Wedge-Tailed Goat-Sucker (*Podargus Stanleyanus*). Mr. Swainson also cites it as a species.

* *Podargus* must be meant.

P. Javanensis of Horsfield, the Chabba-Wonno of the Javanese, is an Asiatic example of this genus. In general colour it is ferruginous or rufous, with a tint of isabella, varied by undulated transverse bands of dark brown; a collar of pale whitish isabella, variegated with two very narrow bands of deep brown, passes round the lower part of the neck, and from this collar several large irregular white marks are disposed in an interrupted series from the axilla to the middle of the back; on the breast and belly several white feathers are scattered; the transverse bands are strongest on the rounded tail; feet rufous; claws blackish; bill obscure yellow and rather shining; middle toe not dentated. Length, 9 inches.

Chabba-Wonno (*Podargus Javanensis*).

The habits of this bird are not known. It is nocturnal, and conceals itself in large forests.

The other two sub-genera arranged by Mr. Swainson under the genus *Podargus* are *Ægotheles*, Horsfield and Vigors, and *Nyctibius*, Vieillot.

Mr. Allis has stated that the sclerotic ring of the great *Podargus* does not present the slightest appearance of distinct plates, being simply a bony ring.

M. Lesson is of opinion that *Steatornis* [GUACHARO BIRD] forms the passage between the *Caprimulgi* and the Crows.

Caprimulgus, Linnæus.—Bill remarkably small and weak; the sides inflexed and sometimes gaping; tarsus short; all the toes directed forwards; the inner and outer toes equal; the middle claw pectinated. (Swainson.)

Mr. Swainson subdivides the genus into the following subgenera:—

Caprimulgus.—Gape strongly bristled; tail lengthened, rounded; lateral toes equal. (Swainson.)

C. Europæus, the Common Goat-Sucker. The male has its plumage above and that of the throat ash-gray, thickly streaked and spotted with brown mostly of a yellowish tinge; head and neck with longitudinal blackish streaks; a white stripe beneath the base of the lower mandible extends along each side of the lower part of the head, and there is a central patch of white upon the throat; quills with the outer webs blotched with reddish-brown, and the three exterior feathers with a large white patch near the tips of the inner webs; tail irregularly marked and indistinctly barred with blackish-grey and yellowish-brown; the two external feathers on each side white at their termination; plumage of the under parts yellowish-brown, with transverse blackish bars; bill and irides dark brown; tarsi paler. Female with the plumage of the male generally, but she wants the white spots on the quills and tail-feathers.

This is most probably the Αἰγοθήλας (or Goat-Sucker) of Aristotle and the Greeks, and the *Caprimulgus* of Pliny and the Romans. There is indeed, as we shall presently see, another European species, but it is very rare. The *Caprimulgus Europæus* is the Calcabotto Piattaglione, Porta Quaglie, Boccaccio, and Cova-Terra, of the Italians; Chotacabras of the Spaniards; Tette-Chevre, Engoulevent Ordinaire, and Crapaud Volant, of the French; Milchsauger, Geissmilcher, Nacht Rabe, Nacht Schwalbe, and Tag-Schlafer, of the Germans; Natskraffa, Natskarra, and Quallknarren, of the 'Fauna Suecica;' Nat-Ravn, Nat-Skade, and Aften-Bakke, of Brunnich; Muckenstecker and Nachtrabb of Kramer; Aderyn y droell, Rhodwr of the Welsh; and Goat-Sucker, Night-Jar, Jar-Owl, Churn-Owl, Fern-Owl, Dor-Hawk, Night-Hawk, and Wheel-Bird, of the English.

Common Goat-Sucker (*Caprimulgus Europæus*).

The absurd story of the goat-sucking habits of this bird may be traced back as far as the time of Aristotle, and is probably of much older date. It has all the appearance of a deep-rooted popular prejudice, which was so extensively believed when that zoologist wrote, as to demand, in his opinion, insertion in his 'History of Animals.' In the ninth book of that history (c. xxx.), Aristotle says, "The bird called *Ægothēlas* is a mountain-bird, a little larger than the blackbird (κοττύφου), and a little less than the cuckoo. It lays eggs to the number of two or three at most, and is of a slothful nature (βλακικός). Flying upon the goats, it sucks them (θηλάζει δὲ τὰς αἶγας προσπετόμενος), whence it has its name. They say that when it has sucked the teat it becomes dry, and that the goat becomes blind. It is not sharp-sighted by day; but it sees by night." Ælian's version of the effect of the bird's sucking is confined to the part sucked. He says that the operation makes the teat dry or blind (τυφλοῖ μασθόν), and so the flow of the milk is stopped. He speaks of the great audacity of the bird, observing that it is fearless of the vengeance

Head and foot of Common Goat-Sucker (*Caprimulgus Europæus*).

of the goatherds (iii. 39). Ælian also refers to its goat-sucking propensity in c. 22 of book xvi. Pliny ('Nat. Hist.,' ix. 40) states that the "*Caprimulgi* are nocturnal thieves: for they cannot see by day (interdiu enim visu carent). They enter the folds (stabula), and fly to the udders of the goats in order to suck the milk, from which injury the udder dies away, and blindness falls upon the goats which have been so sucked." Nor is the charge of goat-sucking the only false accusation made against the Night-Jar. White ('Selborne') informs us that the country-people have a notion that the fern-owl, or churn-owl, or eve-jarr, which they also call a puckeridge, is very injurious to weanling calves, by inflicting, as it strikes at them, the fatal distemper known to cow-leeches by the name of puckeridge. "Thus," says White, "does this harmless ill-fated bird fall under a double imputation, which it by no means deserves; in Italy, of sucking the teats of goats, whence it is called the *Caprimulgus*, and with us, of communicating a deadly disorder to the cattle. But the truth of the matter is, the malady is occasioned by the *Œstrus bovis*, a dipterous insect, which lays its eggs along the chines of kine, where the maggots, when hatched, eat their way through the hide of the beast into the flesh, and grow to a very large size." (White, 'Selborne.') Belon, in his folio edition (1555), gives no figure of this species, but appears to confound it with an Owl, 'L'Effraye' or 'Fresaye.' In the small 4to. 'Portraits d'Oyseaux,' &c. (1557), a figure is given at the end of the owls, which, though bad, cannot be mistaken for anything but the Goat-Sucker, with the titles of 'Αἰγοθήλας, *Strix Caprimulgus, Fur nocturnus*, Effraye, Frezaye,' with the following old quatrain:—

"Le hideux cry de la Frezaye effraye
Celuy qui l'oit: elle vole de nuict,
Et à tetter les chevres prend deduict.
T'esbahis-tu s'elle se nom Effraye?"

The food of the European Goat-Sucker consists chiefly of night-flying and evening-flying moths and beetles, *Phalænæ, Melolonthæ*, &c. In the stomach of one which Willughby opened were seeds as well as beetles. The Fern-Chafer, *Melolontha solstitialis*, seems to be a favourite food, and hence the bird is frequently found in those neighbourhoods where fern abounds. It spends the summer in the temperate countries of Europe, but on the approach of winter retires to the south of the Mediterranean Sea. Its arrival in these islands may be looked for from the middle of May to the end of that month, and its departure takes place towards the end of September or beginning of October. The earliest appearance of the bird in White's 'Calendar' is dated on the 1st of May, and the latest on the 26th of that month. The last-named naturalist paid particular attention to the habits of this species. "There is no bird, I believe," writes that delightful observer, in a letter to Pennant, "whose manners I have studied more than that of the *Caprimulgus* (the Goat-Sucker), as it is a wonderful and curious creature; but I have always found that though sometimes it may chatter as it flies, as I know it does, yet in general it utters its jarring note sitting on a bough; and I have for many an half-hour watched it as it sat with its under mandible quivering, and particularly this summer. It perches usually on a bare twig, with its head lower than its tail, in an attitude well expressed by your draughtsman in the folio 'British Zoology.' This bird is most punctual in beginning its song exactly at the close of day; so exactly that I have known it strike up more than once or twice just at the report of the Portsmouth evening gun, which we can hear when the weather is still. It appears to me past all doubt that its notes are formed by organic impulse, by the powers of the parts of its windpipe, formed for sound, just as cats pur. You will credit me, I hope, when I assure you that, as my neighbours were assembled in an hermitage on the side of a steep hill, where we drink tea, one of these churn-owls came and settled on the cross of that little straw edifice and began to chatter, and continued his note for many minutes; and we were all struck with wonder to find that the organs of that little animal when put in motion gave a sensible vibration to the whole building! This bird also sometimes makes a small squeak, repeated four or five times; and I have observed that to happen when the cock has been pursuing the hen in a toying way through the boughs of a tree." Again:—"On the 12th of July I had a fair opportunity of contemplating the motions of the *Caprimulgus*, or Fern-Owl, as it was playing round a large oak that swarmed with *Scarabæi solstitiales*, or Fern-Chafers. The powers of its wing were wonderful, exceeding, if possible, the various evolutions and quick turns of the swallow genus. But the circumstance that pleased me most was, that I saw it distinctly, more than once, put out its short leg, while on the wing, and by a bend of the head deliver somewhat into its mouth. If it takes any part of its prey with its foot, as I have now great reason to suppose it does these chafers, I no longer wonder at the use of its middle toe, which is curiously furnished with a serrated claw." Mr. Vigors (loc. cit.) remarks that the Common Barn-Owl (*Strix flammea*) possesses the same character of serrated unguis: and that some other species of the *Strigidæ* exhibit somewhat of the rudiments of it; thus establishing more closely the affinity of the Owls and the *Caprimulgi*. Mr. Vigors adds that his conjecture as to the use of the serrated claw—that is, its being devoted to the purposes of seizure—is considerably corroborated by the passage from White above quoted. At the same time he refers to Wilson, who in his account of the *Caprimulgus Carolinensis* (*Antrostomus Carolinensis* of Prince C. L. Bonaparte) assigns a different use to this serrated claw. Of this species Wilson says, "Reposing much during the heat of the day, they are much infested with vermin, particularly about the head, and are provided with a comb on the inner edge of the middle claw, with which they are often employed in ridding themselves of these pests, at least when in a state of captivity." Upon this Mr. Vigors observes that such can be at best but an accidental use to which the serration can be applied. There are many other groups of birds, he adds, possessing the same character, to which the same application of it can never be assigned—for instance, the greater part of the genus *Pelecanus* of Linnæus. Many of these birds, whose feet, Mr Vigors observes, are naturally ill adapted by their webbed structure for laying hold of any object, are yet found to incubate among trees, where the serrated claw may give them a further power of prehension; they are also, he remarks, asserted to seize their prey occasionally with the foot; in which acts the structure of the nail, as in the case cited by White respecting the *Caprimulgus*, may be peculiarly useful. "The family of the *Ardeidæ* among the wading birds equally exhibit," says Mr. Vigors, in conclusion, "an analogous construction in the middle nail. Here again this character seems adapted to their mode of life in enabling them to hold their prey more firmly in those slimy and muddy situations where it might otherwise elude them; while, at the same time, it may assist their feet (which, like those of the *Pelecanidæ*, are naturally ill suited for grasping) in their hold among the trees, where, like some also of the latter family, they build their nests." Mr. Dillon is of opinion that the chief use of the serrated claw is simply to comb out or dress the vibrissæ which surround the gape. Mr. Swainson opposes this view, observing that there is an American group of this family which have no bristles round the bill, and yet have the serrated claws; and another group in Australia which have bristles round the bill, and yet with the claw smooth and simple. He also observes that the Heron tribe have the gape smooth, but the claw serrated. Mr. Rennie remarks that the passage in Wilson "appears to settle the question;" but he gives no satisfactory reason why.

Psalurus macropterus (old male).

The Goat-Sucker is sometimes to be seen abroad in gloomy days; we have seen it on such days, and generally on the ground. On a tree it is observed to perch not across a branch, but on its longitudinal direction. These birds affect the neighbourhood of oaks, where in May they find the *Melolontha vulgaris*, and at Midsummer the *M. solstitialis*. White graphically describes the evolutions of one round his 'great spreading oak,' where it was hawking after a brood of some particular *Phalæna* belonging to that tree. On this occasion he says it exhibited a command of wing superior to the swallow itself. The same author states that when a person approaches the haunts of this species in an evening they continue flying round the head of the obtruder; and by striking their wings together above their backs, in the manner that the pigeons called Smiters are known to do, make a a short snap; perhaps at that time, he adds, they are jealous of their young, and their noise and gestures are intended by way of menace. The eggs, two in number, oblong, white or dusky, and streaked somewhat like the plumage of the bird, are equal in size at each end, and are laid on the bare ground, generally among fern, heath, or long grass, sometimes in furze-brakes or woods, but always near the latter. Montagu describes the noise made by the male during incubation when perched, and with his head downwards, as not unlike that of a spinning-wheel, and notices its uttering a sharp squeak as it flies.

The other European species, *Caprimulgus ruficollis*, which is very rare, has been shot in the oak-woods some miles distant from Algeziras, and also in the valley of the Rio del Mel, near that city. The Spanish name for it is Samala. Mr. Gould has no doubt that its natural habitat is Northern Africa. Prince Bonaparte notes it as occurring in south-western Europe during the summer.

Mr. Gould has established a new genus for some of the American *Caprimulgi*, under the name of *Antrostomus*. [WHIP-POOR-WILL.]

Psalurus (Sw.).—Gape strongly bristled. Tail excessively long, and very deeply forked.

P. macropterus. A bright ruddy demi-collar ornaments the back part of the neck, and the two external tail-feathers in the male are much longer than the others. The tail of the female is much shorter. It is a native of Paraguay and Brazil.

Chordeiles (Sw.).—Gape perfectly smooth. Wings very long, equal to the tail, which is slightly forked.

C. Americanus. Ground of plumage above, sides of the head, and front of the neck, dark liver-brown, glossed with greenish. Head, neck, and upper rows of lesser wing-coverts, spotted with yellowish-brown; back, scapulars, and tertiaries, mottled with brownish-white and a little wood-brown, the pale colour forming speckled bars on the tail and its coverts; intermediate wing-coverts more thickly mottled with a purer white: greater coverts spotted with brown on the margin; band on middle of quills, beginning on the inner web of the first and ending with the fifth, and a broad arrow-shaped mark on the throat, pure white. A white dotted superciliary band reaches to the nape. Lateral tail-feathers banded with white. Plumage below and inner wing-coverts barred alternately with brownish-white and liver-brown. Bill blackish. Legs pale. Tail forked. Middle toe, which is longest, with a serrated claw.

This is the *Caprimulgus Americanus* of Wilson, and the *C. Virginianus* of Prince Bonaparte, who notices the bird in his 'Geographical and Comparative List,' as *Chordeiles Virginianus* (Bonap.), and *Caprimulgus Popetue* (Vieill.). It is the Peesquaw of the Cree Indians.

Sir John Richardson says that few birds are better known in the Fur Countries than this, which ranges in summer even to the most remote arctic islands. Colonel Sabine notices it, in the appendix to Captain (now Sir Edward) Parry's 'First Voyage,' as the Musquito Hawk, and states that a female was found on Melville Island, lying dead on the ground about a quarter of a mile from the sea. He adds, that these birds are known to breed and inhabit as far north as Hudson's Bay; but as they live principally in woods, and feed on musquitoes and other winged insects, which are very rare in the North Georgian Islands, it is more than probable that the individual found dead was an accidental visitor, and had perished for want of food. It was extremely thin, but the plumage was in good preservation. Fabricius does not mention it, he observes in conclusion, as known in Greenland. Sir John Richardson states that its very peculiar noise is most frequently heard in the evening, and often seems to be made close to the listener, though the bird that produces it is so high in the air as to be nearly imperceptible. He describes this sound as resembling that produced by the vibration of a tense thick cord in a violent gust of wind, and says that the Pisk (the common name for the bird) considerably resembles some of the *Falconidæ* in its evolutions in the air. It often remains stationary, fluttering its wings rapidly, and then suddenly shoots off a long way by a gliding motion: at that moment the loud vibratory noise is heard. "It also traverses the air backwards and forwards, quartering the sky as regularly as the Hen Harrier surveys a piece of ground. The female deposits her eggs on the ground without making any nest, generally selecting the border of a cultivated field or an open glade in the forest, and during incubation sits so close that she may be almost trodden down. When any person approaches her the male sallies from the adjacent thicket and stoops at the intruder, passing within a foot or two of his head, then rising again and wheeling round to repeat the same manœuvre. In the meanwhile his mate flutters from the nest along the ground as if disabled, and hides herself at a short distance among the gray grass, from which she can hardly be distinguished. The Pisk makes its first appearance at Great Bear Lake generally about the last day of May, and was observed hatching on the Saskatchewan on the 8th of June. Its eggs are narrower than those of *Caprimulgus vociferus*, but of the same colours, rather differently distributed; they measure nearly 14 lines in length." ('Fauna Boreali-Americana.')

Pisk (*Chordeiles Americanus*).
Upper figure, male; lower figure, female, with an egg.

Sir John Richardson states the extreme northern range of this bird as 68° N. lat. (east of the Rocky Mountains, migratory), and he notices it as observed in the summer, when it is common, on the Saskatchewan, lat. 53° to 54° N., and from 600 to 1000 miles distant from the sea-coast; as very common in the vicinity of Philadelphia, lat. 40° N. (Bonaparte), but as not having its winter-quarters in the United States. It also appears in Sir John's list of species which summer or breed in the Fur Countries and in Pennsylvania, but winter farther to the southward. In Prince Bonaparte's 'Geographical and Comparative List,' the southern and central parts of North America are recorded as the localities of the species.

Scotornis (Sw.).—General structure of *Caprimulgus*; but the outer toe is shorter than the inner.

Sub-genera, *Scotornis.*—Rictus strongly bristled. Tail lengthened, graduated, or rounded. (Sw.)

S. climaturus, African Long-Tailed Night-Jar. Its size is rather smaller than that of *Macrodipteryx*, although, from the development of its tail, it is much longer. The bristles considerably exceed the length of the bill; the third quill is longest; the first is rather shorter than the fourth, while the fifth is $\frac{8}{10}$ths of an inch shorter than the fourth. The tail is very long, measuring from the base 9 inches, of which 3¼ inches are occasioned by the two middle tail-feathers exceeding the others; the outer lateral toe is shorter than the inner. The ground colour of the plumage is light ferruginous-brown varied with dark freckles. The chin and rictal stripe white; the lesser wing-coverts have at their tips a broad band of white, and the greater have a terminal spot of cream-colour, much smaller than the former. The ground colour of the five primary quills

is entirely black, without any rufous, their tips only being freckled with gray; but they are crossed in the middle by a snowy-white broad band beginning in the inner web of the first and terminating on the outer web of the sixth quill: the remaining quills are varied with black and rufous and tipped with white. The tail is variegated in the usual manner, the middle pair of feathers having about twenty very slender transverse bars, but much undulated, while the outer margin of the exterior feather, and the tips of that and of the next are pure white. No gray in the plumage. Total length, including tail, 13 inches. (Sw.)

It is a native of Africa, and is common in Senegal.

African Long-Tailed Night-Jar (*Scotornis climaturus*). (*Caprimulgus climaturus*, Vieill.)

Macrodipteryx (Sw.).—Rictus strongly bristled; wings long, equal to the tail, and with a lengthened reniform feather in each. Tail even.

M. Africanus, Pennant-Winged Night-Jar, or Long-Shafted Goat-Sucker. It has wings, for the small size of the bird, very long, rather exceeding, or at least equalling, the tip of the tail, which is quite even and consists of ten feathers. Of the first three quills, which are much the longest, the first is shorter than the third, which is slightly succeeded by the second. The long-shafted feathers are inserted immediately between the primary and secondary quills. The bristles of the mouth are strong and equal to the length of the bill, which is weak. The middle toe is lengthened, and the lateral toes are equal. Colour of the plumage mixed, as in others of the family. Upon each web of each of the primary quills is a row of nine rufous and nine black spots: the rufous bars become very small towards the tips, where the black predominates. The lesser quills are black, with four rufous bands, the tips black. The middle tail-feathers are gray, speckled with black points, and crossed by six black bars, all of which are irregular, excepting the last, which, as on all the other feathers, is regular, well defined, and placed just behind the tips; the outer web of the exterior feather is fulvous white, with about ten black spots, at equal distances from each other. Some of the scapulars have a broad cream-coloured stripe, which forms a connected series when the feathers lay over each other, but those which are conspicuous on the supposed female can scarcely be discerned in the male; this latter however has a few obscure white mottles on the chin, throat, and round the ears. Total length about 8 inches.

Mr. Swainson, from whose 'Birds of Western Africa,' the above description is taken, observes that the female is entirely destitute of the long-shafted or supplementary feathers. "Now this," says Mr. Swainson, "is a very important fact, for it goes far to prove that they are not essential to the economy of the species; for if otherwise, both sexes would possess them, unless it be contended, a supposition highly improbable, that the male feeds in one manner and the female in another. In the absence of all information upon this point, we are led to conclude that they are more ornamental than useful, given to the male sex as attractive decorations to the female, in a similar manner as the flowing feathers of the Paradise Bird are known to distinguish the male sex. Whether or no these ornamental plumes are lost after the season of incubation is a subject for future inquiry;

but they are certainly of very unequal lengths in different individuals. We have seen them in one bird only 7 inches long, while in that now before us they measure in extreme length 17 inches; the webs occupy exactly six, while all the rest of the shaft is naked, the rudimentary

Pennant-Winged Night-Jar, or Long-Shafted Goat-Sucker (*Macrodipteryx Africanus*). Male.

hairs on each side merely indicating the position of the laminæ, had they been developed. We cannot subscribe to an opinion we have heard expressed, that these latter have been rubbed or worn off.

Proïthera diurna.

Another specimen, which we suppose is the female, is perfect in all its plumage, but has no indication, as already observed, of these feathers. In their texture they are remarkably flexible, moving about with the least breath of wind. The inner web is so broad, that the laminæ in the middle measure 2½ inches; the outer web, on the contrary, is very narrow, and the longest laminæ are hardly half an inch."

This is the *Caprimulgus Macrodipterus* of Afzelius, and the *Caprimulgus longipennis* of Shaw.

It is a native of Sierra Leone, Africa.

Proïthera (Sw.).—Rictus almost smooth; wings very long, equal to the tail, which is short and even; tarsus very naked.

P. diurna (*Caprimulgus diurnus*, Wied., *Nacunda*, Temm.). The plumage of the female is above a mixture of gray-brown, yellowish-red, and brownish-black, marked with great spots of blackish-brown, with wide borders of yellowish-red; chin pale-yellow, striped with gray-brown; tail marbled with brownish-black and bright-yellow, with nine or ten transverse bands speckled with brownish-black. Plumage beneath white lineated with gray-brown; middle of the belly white, spotless. Length rather more than 10 inches.

It is a native of Brazil and Paraguay.

GOAT'S-THORN. [ASTRAGALUS.]

GOAT-WEED. [ÆGOPODIUM.]

GO'BIO, a genus of Fishes belonging to the section *Malacopterygii Abdominales* and family *Cyprinidæ*. The species of this genus differ chiefly from the true Carps in having the anal and dorsal fins short and destitute of bony rays. *G. fluviatilis* (Ray), the Common Gudgeon, affords the best example of this genus.

The Gudgeon is a British fish, and is found in many streams that in their course flow over gravelly soils. The Thames, Mersey, Colne, Kennet, and Avon, produce fine Gudgeons. They swim together in shoals, feeding on worms, aquatic insects, and their larvæ, small molluscous animals, ova, and fry. They afford ample amusement to those sportsmen who are satisfied with numbers rather than weight. The Gudgeon rarely exceeds 8 inches in length. It spawns in May, and the young are about an inch long in August.

GO'BIUS, a genus of Acanthopterygious Osseous Fishes belonging to the family *Gobioidæ*. All the species have two dorsal fins, scaly bodies, and a disc beneath the throat formed by the united ventral fins. By means of this disc they have the power of attaching themselves to rocks. Several species of Goby are met with on the British coast. The largest is the *Gobius niger* of Linnæus, which attains the length of 6 inches, and ranges from Cornwall to the Orkneys. Mr. Couch has inquired into the habits of the Black Goby, and finds that when it has seized its prey it carries it off alive in its mouth to its resting-place, which is among rocks. The other British Gobies, *G. bipunctatus*, *G. minutus*, *G. gracilis*, and *G. unipunctatus*, are mostly inhabitants of sandy ground. On the shores of the Mediterranean Gobies abound, and are also found in deep water, even to a depth of 50 fathoms. The deep-water species are distinct from those frequenting the coast-line.

The species of *Gobius* are very tenacious of life, and are capable, like their neighbours, the Blennies, of living some time out of water. The most remarkable fact connected with the history of these fishes is their nidification. That the Goby built a nest was known to the ancient Greeks. This nest they construct in spring, of seaweeds, &c., and in it the female deposits her eggs, whilst the male watches over them until they are hatched. The nest of the Goby is very well built, and has of late been observed on our own coasts. True Gobies occur in the seas of the southern hemispheres as well as in those of the northern.

GOBY. [GOBIUS.]

GODWIT. [SCOLOPACIDÆ.]

GOLD, one of the precious metals. It differs remarkably from other metals, with a very few exceptions, in the fact that it is found in nature in its metallic state. It is occasionally found mineralised by tellurium. Native gold is Monometric, and occurs in cubes without cleavage, also in grains, thin laminæ, and masses, sometimes filiform or reticulated. The colour varies in shade, sometimes being a bright yellow, at others almost silvery-white, from the quantity of silver with which it is mixed. It is very ductile and malleable. Hardness 2·5 to 3. Specific gravity 12 to 20, varying according to the metals alloyed with the gold. Native gold usually contains silver, and in very various proportions. The finest native gold from Russia yielded—gold 98·96, silver 0·16, copper 0·35, iron 0·05; specific gravity 19·099. A gold from Marmato afforded only 73·45 per cent. of gold, with 26·48 per cent. of silver: specific gravity 12·666. This last is in the proportion of 3 of gold to 1 of silver. The following proportions have also been observed:—3½ to 1, 5 to 1, 6 to 1, 8 to 1; and this is the most common; 12 to 1 also is of frequent occurrence.

Copper is often found in alloy with gold, and also Palladium and Rhodium.

A Rhodium Gold from Mexico gave the specific gravity 15·5 to 16·8, and contained 34 to 43 per cent. of rhodium.

Iron and copper pyrites are often mistaken for gold by those inexperienced in ores. Gold is at once distinguished by being easily cut in slices and flattening under a hammer. The pyrites when pounded are reduced to powder: iron pyrites is too hard to yield at all to a knife, and copper pyrites affords a dull greenish powder. Moreover the pyrites give off sulphur when strongly heated, while gold melts without any such odour.

Native Gold is to a large extent obtained from alluvial washings. It is also found disseminated through certain rocks, especially quartz and talcose rocks, and it is often contained in pyrites, constituting the auriferous pyrites; the detritus affording gold-dust has proceeded from some gold-bearing rocks.

Gold is widely distributed over the globe. It occurs in Brazil (where formerly a great part of that used was obtained), along the chain of mountains which runs nearly parallel with the coast, especially near Villa Rica, and in the province of Minas Geraes; in New Granada, at Antioquia, Choco, and Grion; in Chili; sparingly in Peru and Mexico; in the southern of the United States. In Europe it is most abundant, in Hungary, at Königsberg, Schemnitz, and Felsobanya, and in Transylvania, at Kapnik, Vorospatak, and Offenbanya; it occurs also in the sands of the Rhine, the Reuss, and the Aar; on the southern slope of the Pennine Alps, from the Simplon and Monte Rosa to the valley of Aosta; in Piedmont; in Spain, formerly worked in Asturias; in the county of Wicklow in Ireland; and in Sweden at Edelfors. In the Ural Mountains there are valuable mines, also in the Cailles Mountains in Little Tibet. There are mines in Africa at Kordofan, between Dar-fur and Abyssinia; also south of Sahara, in the western part of Africa from Senegal to Cape Palmas; also along the coast opposite Madagascar, between 22° and 23° S. lat., supposed to have been the Ophir of the time of Solomon. Other regions in which gold is found are China, Japan, Formosa, Ceylon, Java, Sumatra, and the Philippines.

Until lately nearly all the gold of commerce came from Asiatic Russia and Mexico, but recent discoveries of gold in California and Australia have opened new and vast sources of supply.

From 1600 to 1700 the entire supply of gold for Europe was obtained from America, whose mines are estimated in the one hundred years to have produced 337,500,000*l.* worth of the precious metal. During the 18th century the supply of gold and silver was still mainly derived from the Americas, the great mine of Valenciana, producing 125,000*l.* sterling per annum for 40 years, and the district of Zaccatecas adding largely to the amount, although these were rapidly failing towards the end of the century. A great increase of gold was produced from the mines of Russia, which are still very productive; they are principally alluvial washings, and these washings seldom yield more than 65 grains of gold for 4000 lbs. of soil, never more than 120 grains. The alluvium is generally most productive, where the loose material is most ferruginous. The mines of Ekaterinburg are in the parent rock—a quartz constituting veins in a half-decomposed granite called Beresite, which is connected with talcose and chloritic schists. The shafts are sunk vertically in the beresite, seldom below 25 feet, and thence lateral galleries are run to the veins. These mines afforded between the years 1725 and 1841 679 poods of gold, or about 30,000 lbs. troy. The whole of the Russian mines yielded in 1842, 970 poods of gold, or 42,000 lbs. troy, half of which was from Siberia, east of the Urals. In 1843 the yield was nearly 60,000 lbs. troy; in 1845, 62,000 lbs. troy; and in 1846, 75,353 lbs.

In the five following years to 1851 nearly 296,932 lbs. troy weight of gold have been raised in Russia.

At the Transylvania mines the gold is obtained by mining, and these mines have been worked since the time of the Romans. The annual yield of Europe exclusive of Russia is not above 250,000*l.* The sands of the Rhône, Rhine, and Danube contain gold in small quantities. The sands of the richest quality contain only about 56 parts of gold in 100,000,000. Sands containing less than half this proportion are worked. Africa yields annually at least 4500 lbs. troy, and Southern Africa 1250 lbs. The mines of the United States have lately produced about 1,000,000 dollars a year.

In South America the gold region of California extends along the valley of the Sacramento and the valley of San Joaquin, immediately south. The gold occurs in flattened grains, or scales, and occasionally in lumps of large size. The yield is enormous. The amount received at the mint in the United States in 1851 was at the rate of 32,000,000 dollars a year. The aggregate production of gold in South America does not appear to have increased within the last five years. The rate of produce in the Australian mines is as follows:—The Sydney district produced from 29th May 1851 to 31st October 1851, 67,152 oz. gold, value 214,886*l.*, or to November 1851, 79,340 oz. gold, value at 257,855*l.* 7*s.*, and to December 31, 142,975 oz. gold, value 464,668*l.* 15*s.* In the Victoria district to the end of December 1851, Ballarat produced 25,108 oz., value 75,324*l.*; Mount Alexander, 30,007 oz., value 96,021*l.* In December there was shipped from Victoria 145,116 oz., on the 8th January, 75,188 oz. Only about two-fifths of the gold realised is sent by the Government escort, hence there is much difficulty in arriving at the actual amount. But the imports to this country may be safely relied on as representing the maximum produce of our colonial gold-fields, and the auriferous districts of America.

From November 1850 to June 1851 the Bank of England issued 9,500,000 sovereigns, being at the rate of 18,000,000 a year, and so great is the increasing demand for gold coins, that the rate of production can scarcely keep pace with it.

It may be interesting to know that from the account kept at the Bank when the light coin was called in, in 1842, that 12,000,000*l.* were received light, and 36,000,000*l.* still circulated of full weight; 40,000,000*l.* may therefore be regarded as the quantity of gold coin in circulation, allowing from 3 to 4 per cent. for the natural wear of the coin. The following table gives over an extended period the

Coinage of Great Britain.

Reign of	No. of Years.	Gold.	Silver.	Total.
James I.	22	3,666,389	1,807,277	5,473,666
Charles I.	35	3,465,188	9,776,544	13,241,732
Charles II. . . .	22	4,177,253	3,722,180	7,899,433
James II.	4	2,113,638	2,115,115	4,228,753
William and Mary . .	12	2,314,889	7,093,074	9,434,963
Anne	13	2,484,531	618,212	3,102,743
George I. . . .	14	8,492,876	233,045	8,725,921
George II.	37	11,662,216	304,360	11,966,376
George III. . . .	61	75,753,443	6,996,765	82,750,206
George IV.	9	36,147,700	2,216,168	38,363,868
William IV. . . .	7	14,600,000	2,800,000	(?)
Victoria, 1837 to 1841 . .	4	4,991,210	889,102	5,880,312
Victoria, 1842 to 1847 .	5	29,886,457	2,440,614	32,277,071

Total coinage of 32 years ending 1847:—Gold, 90,029,383*l.*; Silver, 13,390,000*l.*; Copper, 248,210*l.*

A large quantity of gold is consumed every year in arts and manufactures, and thus regularly removed from the stock of our circulating wealth. In Birmingham not less than 1000 oz. of fine gold are used every week, and the weekly consumption of gold leaf is as follows:—

	Ounces.
London	400
Edinburgh	35
Birmingham	70
Manchester	40
Dublin	12
Liverpool	15
Leeds	6
Glasgow	6
Total	584 weekly,

of which not one-tenth can be recovered. For gilding metals by the electrotype and the water-gilding processes not less than 10,000 oz. of gold are required annually. One establishment in the Potteries employs 3500*l.* worth of gold per annum, and nearly 2000*l.* worth is used by another. The consumption of gold in the Potteries of Staffordshire for gilding porcelain and making crimson and rose-colour varies from 7000 to 10,000 oz. per annum.

The Indus and the Euphrates were the earliest spots whence man obtained the precious metal gold—Nubia and Ethiopia on the south, and Siberia on the north next opened out their auriferous treasure to gratify human necessity and to indulge human luxury. Europe then began to unfold her golden stores, and Illyria and the Pyrenees, together with the land of the Hungarians and many parts of Germany to the Rhine, were sought successfully for gold. Our islands yielded something to the store, and then the New World of the Americans opened by Columbus a source from which the Old World was to supply its golden waste. On and on still westward rolled the golden ball, until at length it rested in California; Europe and Asia rush equally to that new El Dorado, and the man of China is found at the side of the English gold streamer. Then, as if to double the girdle, the islands of the Pacific and our own Australia open their exceeding stores. (Hunt.)

Australia is undoubtedly the most important gold-bearing district in relation to Great Britain. Her shores are now being crowded with emigrants from the mother country seeking the precious metal, and in proportion to her population she is now undoubtedly, in this point of view, the richest country of the world. For the purpose of guiding those who are seeking Australia on account of its gold, the professors of Natural Science, in the Museum of Practical Geology, delivered a course of lectures in the summer of 1852. These lectures were as follows:—

1. 'The Geology of Australia, with Especial Reference to the Gold Regions,' by J. Beete Jukes, M.A. F.G.S., Local Director of the Geological Survey of Ireland; author of 'Sketch of the Physical Structure of Australia.'

2. 'On our Knowledge of Australian Rocks as derived from their Organic Remains,' by Edward Forbes, F.R.S.

3. 'The Chemical Properties of Gold, and the Mode of Distinguishing it from other Substances resembling it,' by Lyon Playfair, C.B. F.R.S.

4. 'The Dressing or Mechanical Preparation of Gold Ores,' by W. W. Smith, M.A. F.G.S.

5. 'The Metallurgical Treatment and Assaying of Gold Ores,' by John Percy, M.D. F.R.S.

6. 'The History and Statistics of Gold,' by Robert Hunt, keeper of Mining Records.

We subjoin an account of the auriferous rocks of Australia from the lecture of Mr. Jukes:—

"Sir R. Murchison, in his address to the Geographical Society in 1844, alluded to the possibly auriferous character of the Great Eastern Chain of Australia, being led thereto by his knowledge of the auriferous chain of the Ural, and by his examination of Count Strzelecki's specimens, maps, and sections. Some of Sir R. Murchison's observations having found their way to the Australian papers, a Mr. Smith, at that time engaged in some iron works at Berrima, was induced by them in the year 1849 to search for gold, and he found it. He sent the gold to the Colonial government, and offered to disclose its locality on payment of 500*l.* The governor however not putting full faith in the statement, and being, moreover, unwilling to encourage a gold fever without sufficient reason, declined to grant the sum, but offered, if Mr. Smith would mention the locality, and the discovery was found to be valuable, to reward him accordingly. Very unwisely, as it turns out, Mr. Smith did not accept this offer; and it remained for Mr. Hargraves, who came with the prestige of his Californian experience, to re-make the discovery, and to get the reward from government on their own conditions.

"This first discovery was made in the banks of the Summer Hill Creek and the Lewis Ponds River, small streams which run from the northern flank of the Conobalas down to the Macquarrie. The gold was found in the sand and gravel, accumulated especially on the inside of the bends of the brook, and at the junction of the two water-courses, where the stream of each would be often checked by the other. It was coarse gold, showing its parent site to be at no great distance, and probably in the quartz veins traversing the metamorphic rocks of the Conobalas. Mr. Stutchbury, the government geologist, reported on the truth of the discovery, and shortly afterwards found gold in several other localities, especially on the banks of the Turon, some distance north-east of the Conobalas. This was a much wider and more open valley than the Summer Hill Creek, and the gold accordingly was much finer, occurring in small scales and flakes. It was however more regularly and equably distributed through the soil, so that a man might reckon with the greater certainty on the quantity his daily labour would return him. At the head of the Turon River, among the dark glens and gullies in which it collects its head waters, in the flanks of the Blue Mountains, the gold got 'coarser,' occurring in larger lumps or nuggets, but these being more sparingly scattered. The reason of these circumstances, which are common to all auriferous regions, has been given in the former part of this Lecture when speaking of the power of moving water.

"With the subsequent history of the 'gold diggings' of Australia, the discovery of many rich auriferous districts, both in New South Wales and Victoria, you must all be more or less familiar.

"In Mr. Arrowsmith's map, appended to the Parliamentary Report just issued, all the auriferous spots are marked in yellow. They occur at intervals along the flanks of the Great Eastern Chain, or on its lateral spurs and subordinate ranges through an extent of country about 1000 miles in length, about as far as from London to Gibraltar or the confines of Turkey, or as from London to Iceland in a straight line. The principal localities marked on this map are Grafton Range and Burnet River, north of the Condamine; Stanley Creek and Canning Downs in the Moreton Bay district; several spots in the neighbourhood of Liverpool Plains; the Turon and Conobalas on the Macquarrie, below Bathurst; the Abercrombie River at the head of the Lachlan; some spots on each side of Breadalbane Plains; the Braidwood and Araluen diggings in the Shoalhaven district; Lake Eimeo in the Australian Alps; and Ballarat, and Mount Alexander and Mount Blackwood, north-west of Port Philip.

"In every one of these localities granite and metamorphic rocks occur, and quartz veins are frequently spoken of. This is an important fact to bear in mind.

"In scarcely any of them do we find mention made of the gold being seen in the actual rock, but in the drift clay, sand, and gravel, or lying loose on the surface of the ground. The hundredweight of gold, indeed, found by Dr. Ker north of Bathurst, is described as a block of highly auriferous quartz, lying among a lot of other loose blocks, evidently derived from a broad quartz vein running up the hill behind them. Such a mass, indeed, could hardly be transported far from its original site by any conceivable current of water.

"The superficial drift in which the diggings have been carried on varies in thickness from a few inches to 20 or 30 feet. The following is an extract from a lecture given by a Mr. Gibbon, in Melbourne, and reported in the 'Melbourne Argus,' giving an account of the Ballarat diggings:—'On the surface of the earth was turf in a layer of about a foot thick, below which was a layer of rich black alluvial soil, and below that gray clay; below that again was a description of red gravel, which was sometimes very good; then red or yellow clay, in which gold was found; and then a stratum, varying in thickness, of clay streaked with various colours, and scarcely worth working; and the next stratum was of hard white pipe-clay, which was a decided barrier. Immediately above it however was a thin layer of chocolate-coloured clay, tough and soapy. This was the celebrated blue clay, and was very rich.

"'The ground on which the diggings were situated was a sloping bank. The blue clay is found near the surface on the brow of the hill, that is, at the depth of about a foot; but it is sometimes necessary to dig 20 feet before arriving at it.'

"Mr. Latrobe, governor of Victoria, describes the Ballarat diggings as carried on through—

"'1. Red ferruginous earth and gravel.

"'2. Streaked yellowish and red clay.

"'3. Quartz gravels of moderate size.

"'4. Large quartz pebbles and boulders; masses of ironstone set in very compact clay, hard to work.

"'5. Blue and white clay.

"'6. Pipe-clay.

"'In some workings the pipe-clay may be reached at the depth of 10 or 12 feet, in others not at 30 and upwards.'

"To enter farther into the details of the several diggings would be alike tedious and useless. I must refer you for them to the two Parliamentary Reports published, the one in February and the other in June, and to the many small publications with which the shops are now swarming.

"My object to-night has been to give you such a rough sketch of the geology of Australia, and of the geological facts and principles that ought to guide any one in his search after gold, as may be of use to those intending to emigrate there.

"In conclusion, I may perhaps be allowed to utter one word of advice.

"Gold-digging is very hard work—just such work as you see navigators at in a railway cutting, or brick-makers in a brick-pit. You must work hard all day, lie hard all night, with but little shelter, often with scanty food, and with nothing of what you have probably been accustomed to consider necessary comfort. If you find you have no luck at the diggings, or if your health, or strength, or resolution fail you, do not therefore give up or despond altogether. You go out to dig for gold; do not be ashamed to dig for anything else. I speak to those now who have been hitherto unaccustomed to manual labour. Recollect, it is the avowed object of your voyage, and the only thing you have to trust to. If you fail to dig up gold there are lands to be ploughed, sheep to be herded and sheared, cattle to be tended, corn to be sown and reaped—every one of these fully as honourable occupations as digging for gold. Go, then, with a bold and resolute heart, determined to get your living by the strength of your own arms and the sweat of your own brows; and be assured, that industry and perseverance lead to fortune in Australia with fewer impediments and uncertainties in the way than in any part of the world."

Since the above was written, other districts in Australia have yielded the precious metal, and every day is adding to our knowledge of the wide extension of this metal on the surface of the earth. A few months ago it was announced that gold had been discovered at the Cape of Good Hope; and at the beginning of the present year the late Dr. Stanger delivered a lecture at Natal, in which he pointed out the probability of gold being found in the neighbourhood of that colony. For an account of the Salts of Gold, and its applications in the arts and sciences, see GOLD, in ARTS AND SC. DIV.

(*Lectures on Gold delivered at the Museum of Practical Geology;* Dana, *Manual of Mineralogy.*)

GOLD-CARP. [CYPRINIDÆ.]

GOLDFINCH. [CARDUELIS.]

GOLDFINNY. [CRENILABRUS.]

GOLD-FISH. [CYPRINIDÆ.]

GOLD OF PLEASURE. [CAMELINA.]

GOLDSINNY. [CRENILABRUS.]

GOLT, or GAULT, an argillaceous deposit, separating the upper greensand (also called firestone, malm-rock, &c.) from the lower greensand (also called Woburn sand, iron-sand, &c.). In Kent, Sussex, Surrey, the Isle of Wight, Wiltshire, and Cambridgeshire its geological situation and organic contents may be well studied. The clay of Specton, on the Yorkshire coast, unites the characters of Golt and Kimmeridge Clay. [CHALK FORMATION.]

GOMPHOLITE, a name given by M. Brongniart to conglomerate rocks of the Tertiary series, which in Switzerland are called Nägelflue.

GOMPHONEMA. [DIATOMACEÆ.]

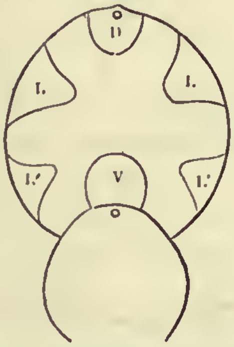
GONGYLOPHIS. [BOIDÆ.]

GONIATITES, an extinct group of fossil shells, belonging to the division of Cephalopodous *Mollusca.* The species which it contains are usually arranged, by writers on organic remains, as a section of Ammonites; but their appropriate characters were never completely given till M. Von Buch, following Haan of Leyden, published his 'General Essay on the Sutures of Ammonites' (read to the Academy of Sciences at Berlin in April, 1830; translated in the 'Annales des Sciences Naturelles,' 1833).

The families or genera of *Nautili* and Ammonites are seldom well understood by the conchological student, because the real distinctions between them are not the most apparent. The most constant of all the characters of Ammonites is the situation of the siphon, which, instead of perforating the disc of the transverse internal plates as in *Nautilus,* touches and lies parallel to the inner face of the shell on the dorsal line. There is another obvious and generally complete distinction in the form of the sutures, or intersections of the transverse internal plates (septa) with the inner surface of the shell. In Ammonites this suture is undulated or angularly bent into lobes and sinuses; in *Nautilus*, even or gently waved. The exceptions to this are few, but remarkable. *Nautilus ziczac* of Sowerby (Dr. Buckland's 'Bridgewater Treatise,' pl. xliii. fig. 3) has sutures waved as much as some true Goniatites, and there is in fact every degree of sinuosity in the edges of the septa of the nautiloid and ammonitic families.

M. Von Buch supposes the sinuous edges of the septa of Ammonites to be necessarily derived from the dorsal position of the siphuncle. "All the other differences," says he, "are derived from this capital distinction. The *Nautilus*, which passes a very large siphon through the middle of the septa, appears sufficiently attached by this membrane to the basis on which it rests. There is no need of any other support, and the septa remain in general smooth and concave without sinuosities on the edges. The small dorsal siphon of the Ammonites would not suffice to secure the animal from displacement on the surface of its cell." Other supports are necessary, and they are found in the marginal lobes which the form of the animal impresses on the partitions of the chambers. These are generally six in number; one ventral V, one dorsal D, and two on each side L, L'. (See *fig.* 1; and Dr. Buckland's 'Bridgewater Treatise.')

Fig. 1.



M. Von Buch, viewing Goniatites as a section of Ammonites, presented the following characters of the group in 1830:—

The lobes of the septa are completely deprived of lateral denticulations or symmetrical crenatures, so that their contour presents always a continuous uninterrupted line. The siphon, compared to that of other Ammonites, is small and delicate; the striæ of growth are sigmoidal on the sides (as in *fig.* 2), inflexed from the aperture on the back, so as to form a sinus there in the aperture, thus resembling *Nautili;* whereas in Ammonites generally the striæ advance along the dorsal line supported probably by the siphon. The last chamber of Goniatites extends, according to Count Münster, more than one turn beyond the concamerations, but in Ammonites only three-fourths of a turn.

Later investigations have scarcely modified these fundamental views, except by showing a greater variety in the forms of the sutures than was at first expected.

Eighteen species of Goniatites are distributed by Von Buch in the following manner:—

Sutures with rounded lobes:—
- *a.* Dorsal lobe simple . . . . . . 4 species.
- *b.* Dorsal lobe double . . . . . 1 species.

Sutures with pointed lobes:—
- *a.* Dorsal lobe simple . . . . . . 6 species.
- *b.* Dorsal lobe double . . . . . 7 species.

Count Münster ('Ann. des Sci. Nat.,' 1834) gives 22 ascertained and 4 doubtful species (mostly different from Von Buch's) from the Fichtel-Gebirge. His arrangement is different, namely:—

1. With simple lobes slightly sinuous and rounded . . . . 4 species.
2. With angular or linguiform lobes:—
   - *a.* Shell entirely involute, sutures with one lateral angular lobe . . . . . 8 species.
   - *b.* Shell entirely involute, sutures with two lateral lobes . . . . 4 species.
   - *c.* Shell evolute, three lateral lobes . . 6 species.

Doubtful species . . . . 4 species.

Martin, in 'Petrificata Derbiensia,' 1809, figured two species of Goniatites; Sowerby, in the 'Mineral Conchology of Great Britain,' added two others; and Professor Phillips, in the second volume of the 'Illustrations of the Geology of Yorkshire,' 1836, has raised the number of British species from the carboniferous limestone, millstone-grit, and coal-formations, to 33 species, the septa of which are completely ascertained.

Beyrich ('De Goniatitis in Montibus Rhenanis Occurrentibus,' 1837) describes 18 species (8 of them supposed to be new), and presents a general classification of all the Continental species supposed to be distinct, at that time known by the descriptions of Haan, Von Buch, Münster, Goldfuss, &c. The number of species of Goniatites at present known is about 150.

In external form Goniatites present an almost complete series of gradations from the involute sub-globular figure, common among *Nautili*, to the discoid spiral shape of the flattest Ammonites. The following figures, from Phillips's 'Geology of Yorkshire,' vol. ii. pl. 19 and 20, will illustrate this:—

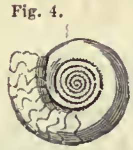
Fig. 2.

Goniatites truncatus. (Phillips.)

Fig. 3.

Goniatites Listeri. (Sowerby.)

Fig. 4.



Goniatites spirorbis. (Phillips.)

Fig. 5.

Goniatites Gibsoni. (Phillips.)

Most of the Goniatites have rounded backs; a few are carinated, as *G. vittiger* and *G. rotiformis*, Phillips.

In nearly all the Goniatites the surface is marked by transverse sigmoidally-bent lines of growth; a few have merely annular striæ; in some these striæ rise into tubercles on the inner edge of the whorls (*G. Listeri*, Sow.; *G. subnodosus*, Münst.). The striæ are occasionally reticulated by spiral lines. Radiating undulations occur on some of the flatter species; in a few (*G. Gibsoni*) there are ribs divided after the manner of many Ammonites; and *G. binodosus*, Münster, has two rows of tubercles. In all these particulars the parallelism of the series of Goniatites to that of common Ammonites is very remarkable.

This analogy with the usual forms of Ammonites is augmented by the occurrence of constrictions on the cast of the interior of the shells. (*Fig.* 3, *c.*) These constrictions, corresponding to internal thickenings of the shell, are most remarkable in the involute Goniatites. (See Phillips's 'Geology of Yorkshire,' vol. ii. pl. xix. fig. 1, 2, 24, 26; pl. xx. fig. 1; Münster, in 'Ann. des Sci. Nat.,' pl. v. fig. 2; and Beyrich, in his 'Dessertation,' tab. ii. fig. 8.) They are parallel or nearly so to the lines of growth, and cross the sutures without any definite relation. They may be viewed as periodical thickenings of the edge of the aperture, and as contributing to strengthen the last chamber of the enlarging shell. They vary as to number and position in individuals of the same species. The aperture of many Goniatites resembles that of the recent *Nautilus Pompilius*.

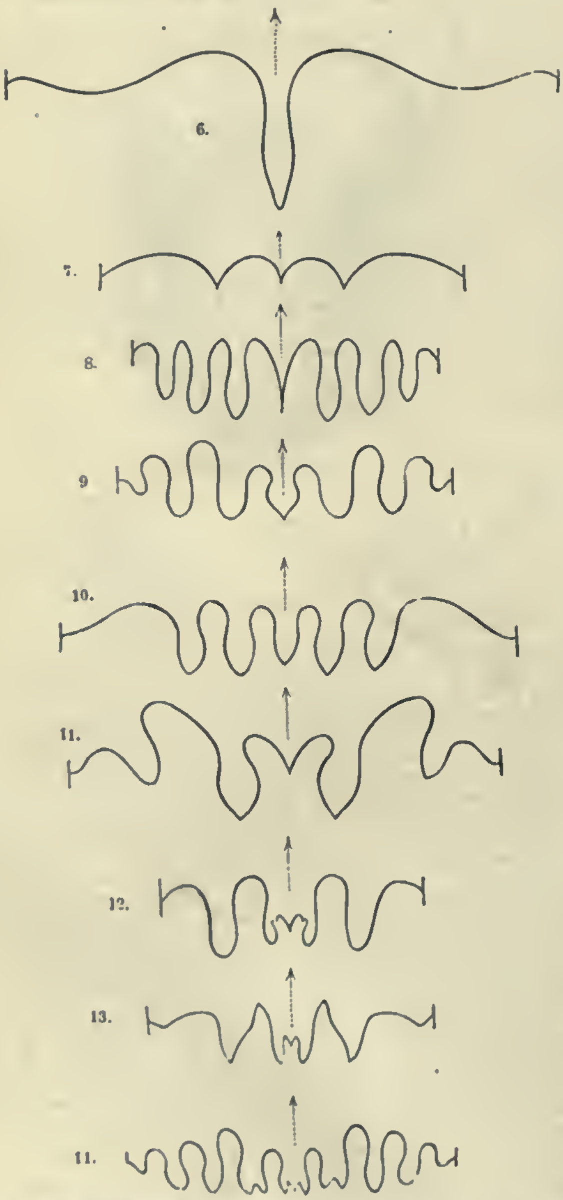
The sutures of the Goniatites are extremely various, beautiful, and characteristic of the species. Individuals of several of the species have been compared almost from the nucleus to full growth without any great change being visible in the form of the septum (as for instance, *G. Listeri*), but in others this is not the case. The following arrangement and accompanying figures will show the principal variations of the sutures. The arrow is in each case supposed to point towards the aperture.

Division 1. The dorsal lobe simple; one lateral lobe.
- *a.* Lateral lobe single and rounded. *G. expansus*, Von Buch, *fig.* 6.
- *b.* Lateral lobe single and angular. *G. sublævis*, Munster, *fig.* 7.

Division 2. The dorsal lobe simple; more than one lateral lobe.
- *a.* Lateral lobes linguiform, and nearly equal. *G. Henslowi*, Sowerby, *fig.* 8.
- *b.* Lateral lobes rounded and nearly equal. *G. serpentinus*, Phillips, *fig.* 9.
- *c.* Inner lateral lobes very much the largest. *G. Munsteri*, Von Buch, *fig.* 10.
- *d.* Lateral lobes very unequal and oblique. *G. Hœninghausi*, Von Buch, *fig.* 11.

Division 3. Dorsal lobe divided; lateral lobe single.
- *a.* Lateral lobes and sinuses rounded. *G. bidorsalis*, Phillips, *fig.* 12.
- *b.* Lateral lobes and sinuses angular. *G. striatus*, Sowerby, *fig.* 13.

Division 4. Dorsal lobe divided or complicated; lateral lobes more than one.
- *G. cyclolobus*, Phillips, *fig.* 14.



The same transition rocks which contain a large portion of the continental species of Goniatites yield a cognate group, from which they are with difficulty distinguished. These were first separated by Count Munster, under the name of *Clymenia*. If Goniatites are considered as of the ammonoid, *Clymeniæ* may be included in the nautiloid type. Their siphon is always on the inner margin, and the septa, instead of a reflex wave on the dorsal line, have there a bend forward toward the aperture. The *Clymeniæ* have all the same variations of form and surface which have been mentioned with regard to Goniatites. *Figs.* 15 to 18 represent the forms of septa of *Clymeniæ*, for comparison with those of Goniatites.

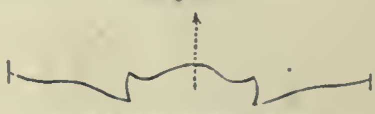
Fig. 15.

Clymenia lævigata. (Münster.)

Fig. 16.

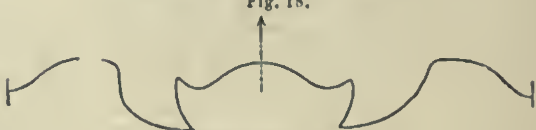
Clymenia compressa. (Münster.)

Fig. 17.



Clymenia planorbiformis. (Münster.)

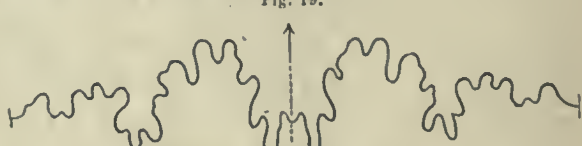
Fig. 18.



Clymenia striata. (Münster.)

Compared with ordinary Ammonites, the differences of the sutures are easily seized; but by the group of *Ceratites* of Haan, which is supposed to be peculiar to the muschelkalk, the transition is not difficult, as the subjoined figures show.

Fig. 19.



Ammonites planicostatus. (Sowerby.)

Fig. 20.

Ceratites nodosus, var.

Goniatites, and their allies, the *Clymeniæ*, appear entirely confined to the rocks of the carboniferous and older systems of strata. Only one species (*Goniatites Listeri*, Sowerby) is mentioned as occurring in the coal-formation, and that in the lowest portion (near Bradford, Halifax, and Sheffield, Yorkshire).

In the strata presumed to lie below the old red-sandstone occur many other species; at least so is the fact on the continent of Europe, though in Great Britain and Ireland they are but rarely met with in the primary and transition strata.

The Goniatites yet described are almost entirely from European localities. Von Dechen quotes *G. Listeri* from India. ('Handbuch der Geognosie.') None are mentioned in the slaty rocks of Westmoreland or Wales; none occur in the Silurian Rocks: they are not rare in Devonshire (occurring about Barnstaple and near Launceston). It is in the North of England, from Derbyshire to the Tweed, and in the limestones of the carboniferous system of strata, that they specially abound. About Enniskillen, and near Castleton, in the Isle of Man, the same rocks yield a considerable number of species.

The following is a list of the British species as given in Tennant's 'British Fossils,' 1847:—

Carboniferous Group.

Goniatites bidorsalis, Phil.	*G. carina*, Phil.
G. biferus, Phil.	*G. crenistria*, Phil.
G. Brownii.	*G. cyclolobus*, Phil.
G. calyx, Phil.	*G. discus.*

G. dorsalis, Brown.
G. evolutus, Phil.
G. excavatus, Phil.
G. expansus, Buck.
G. fasciculatus.
G. foraminosus, Phil.
G. Gibsoni, Phil.
G. Gilbertsoni, Phil.
G. granosus, Portl.
G. Henslowi, Sow.
G. implicatus, Phil.
G. intercostalis, Phil.
G. intermedius, Brown.
G. jugosus, Brown.
G. Kenyoni, Brown.
G. latus.
G. Listeri, Sow.
G. Longthorni, Brown.
G. Loonoyi, Philips.
G. mixonotus, Philips.
G. minutissimus, Brown.
G. mixolobus, Phil.
G. mutabilis.
G. nitidus, Phil.
G. obtusus, Phil.
G. paradoxicus, Brown.
G. parvus, Brown.
G. paucilobus, Phil.
G. platylobus, Phil.
G. proteus, Brown.
G. reticulatus, Phil.
G. rotiformis, Phil.
G. serpentinus, Phil.
G. Smithii, Brown.
G. sphæricus, Sow.
G. sphæroidalis.
G. spirorbis, Phil.
G. splendidus, Brown.
G. stenolobus, Phil.
G. striatus, Phil.
G. striolatus, Phil.
G. subsulcatus, Brown.
G. truncatus, Phil.
G. undulatus, Brown.
G. vesica, Phil.
G. vittiger, Phil.

Devonian Group.

Goniatites biferus, Phil.
G. carbonarius, Sow.
G. crenistria, Phil.
G. excavatus, Phil.
G. globosus, Münst.
G. inconstans, Phil.
G. insignis, Phil.
G. linearis, Münst.
G. mixolobus, Phil.
G. serpentinus, Phil.
G. spiralis, Phil.
G. spirorbis, Phil.
G. transitorius, Phil.
G. vinctum, Sow.

GONIODUS. [Squalidæ.]

GONIO'GNATHUS, a genus of Fossil Cycloid Fishes, from the London Clay. (Agassiz.)

GONIO'PHORUS (Agassiz), a genus of Fossil *Echinida*, from the Greensand. (Morris, *Catalogue*.)

GONIOPORA. [Madreporæa.]

GONOPLACIDÆ, *Gonoplacians*, an order of Brachyurous Crustaceans, whose carapace is either square or rhomboidal, and much wider than it is long. The posterior border, measured between the base of the fifth pair of feet, equals, nearly always, the half of its transverse diameter; while in the tribe of Ocypodians, as well as in the Cyclometopes, and the greater part of the *Oxyrhynchi*, the length of this border is only about a fourth of the greatest width of the carapace. The front is but little inclined, and very wide; it does not curve downwards so as to unite itself throughout nearly its whole width to the epistome, as in the Ocypodians, and it is equal to two-thirds of the buccal frame measured at the point of its greatest width. The ocular peduncles are in general very much elongated and rather small; their length often equals five or six times that of their diameter, and the cornea which terminates them is always small. The external angle of the orbit ordinarily occupies the lateral extremity of the carapace. The internal antennæ are always horizontal, quite exposed, and lodged in little pits (fossettes) distinct from the orbits. The external antennæ are disposed nearly as in the Ocypodians. The epistome is often placed at some distance behind the inferior orbitary border, a character which is always met with in the Cyclometopes, and exists but rarely in the family of Catametopes. The buccal frame is generally wider at its anterior border than at its posterior part, and the fourth joint of the external jaw-feet is inserted nearly always at the internal angle of the preceding articulation. The sternal plastron is very wide, and is sometimes perforated for the passage of the intromissive male organs (les verges); but in general these organs are inserted, as in other families, at the basilary joint of the posterior feet, and are lodged in a small transversal canal hollowed in the sternal plastron at the point of union of its two last segments, a canal which serves them for a sheath till they arrive under the abdomen. The length of the anterior feet varies; it is sometimes very considerable, and those of the third or fourth pair, which are always the longest among the eight last, have nearly two and a half times the length of the post-frontal portion of the carapace: they are all slender, and terminated by a styliform tarsus. The abdomen of the female is very wide, and covers nearly the whole of the sternal plastron; but that of the male, on the contrary, is very narrow, and instead of extending to the basilary joint of the posterior feet, leaves exposed a considerable portion of the sternal plastron between its external edge and the base of those feet. In the greater number of cases its second ring is entirely linear, while the others are sufficiently well developed.

Such is the character given to this tribe by M. Milne-Edwards, who places it between the Ocypodians and the Grapsoidians, and divides it into the four following genera:—

Pseudorhombila (Milne-Edwards). — M. Milne-Edwards states that the crustacean which is the type of this new genus is very remarkable, inasmuch as it holds a middle place between the Cancerians and the Gonoplaxes. The form of its carapace approaches that of the Panopes, and of some other Cancerians, for it is slightly arched in front, and between the orbits and the lateral borders a considerable portion of its contour is curved backwards after the manner of the latero-anterior border of the carapace of the Cyclometopes; but nevertheless its general form is that of a rhomb, and its posterior border occupies more than the third of its diameter. The body is very thick, and much elevated anteriorly. Front nearly horizontal, and divided into two truncated very large lobes. Eyes, antennæ, epistome, and external jaw-feet, presenting the same disposition as in the Crabs. Sternal plastron much wider than long, and very strongly curved from before backwards; at its posterior part, which is very wide, may be remarked on each side, in the male, a canal of considerable calibre, which lodges the intromissive organs, the origin of which may be seen at the base of the posterior feet. The anterior feet are very strong, and very long in the male; the succeeding feet present nothing remarkable, except that those of the form of the abdominal of the same length as those of the third pair, second pair are nearly rather shorter than the following ones. The and that these last are appendages differs but little from the form of those of *Xanthus*.

P. quadridentata. Length about 2 inches; colour rosy. Locality unknown.

M. Milne-Edward adds that the crustaceans figured by De Haan under the name of *Cancer* (*Curtonotus*) *longimanus* ('Fauna Japonica,' Crust., pl. vi. fig. 1) appear to him to come very near the preceding species; but as the description was not published, he could not pronounce upon their identity.

Gonoplax (Leach).—Carapace more than one and a half times as wide as it is long, and rather strongly narrowed backwards; the fronto-orbitary border extends the whole of its width, and the front itself is lamellar, slightly inclined, and terminated by a straight border. The ocular peduncles equal more than a third of the width of the carapace; they are of medium size, and present no notable swelling at their extremity. The internal antennæ are large and of ordinary form; the basilary joint of the external antennæ is small and cylindrical like the following ones, and their terminal stem is very long. The epistome is much less advanced than the lower border of the orbit; the buccal frame is much wider than it is long, and a little narrowed backwards; the form of the external jaw-feet is the same as in the crabs. The disposition of the sternal plastron is nearly the same as in *Pseudorhombila*, but it is to be remarked that the transversal canal which lodges each of the intromissive organs is not completely shut below. The anterior feet are extremely long and nearly cylindrical; those of the second pair are longer than the second or the third; and those of the last pair are nearly of the same length as the second. The abdomen of the male presents seven distinct joints, like that of the female.

G. rhomboides. M. Milne-Edwards remarks, that M. Latreille believed that this species could not be distinguished from *G. angulata*, and says that perhaps it may be only a variety; but he at the same time retains it as a species, and points out certain differences between it and *G. angulata*. Length about an inch; colour yellowish mingled with red.

Gonoplax rhomboides.

It inhabits the Mediterranean and the Ocean, and keeps among rocks at considerable depths, and seems to live solitary. According to M. Risso it swims with facility, and rises often to the surface of the water without ever coming out.

It feeds on small fish and radiated animals.

Professor Bell, in his 'British Crustacea,' says *G. angulata* is a British species, and states his conviction that *G. rhomboides* is only a variety.

Macrophthalmus (Latreille).—A genus with the general contour of *Gonoplax*, but distinguished by the form of the jaw-feet, and above all by the length of the ocular peduncles. Carapace rhomboidal and very wide; the transverse diameter is sometimes twice as long as the longitudinal diameter, and the anterior border occupies the whole length of it; stomachal region small and nearly quadrilateral; branchial regions large and nearly of the same form; front curved downwards, very narrow, and resembling that of *Ocypode;* it only occupies about the fifth of the transversal diameter of the carapace, and does not entirely cover the basilary portion of the ocular peduncles, which are very long, slender, and terminated by a somewhat oval and very small cornea. The orbits have the form of a transversal groove hollowed out under the anterior border of the carapace, and directed obliquely up; within, their inferior border is much more projecting than their superior border, but below the external angle it is incomplete, so that their cavity is not closed at this point. The internal antennæ are lodged under the front, and their stem, of a fair length, is bent transversely; the disposition of the external antennæ is nearly the same as in *Gonoplax*. The epistome is linear, and is continued with the lower orbitary border. The buccal frame is wider than it is long, and arched (cintré) in front. The external jaw-feet do not meet ('ne se rencontrent pas tout-à-fait'); their second joint is very wide, and the third much less, especially anteriorly, supports at the external angle of its anterior border the terminal stemlet ('tigelle terminale'). The sternal plastron is nearly of the same form as in *Gonoplax*, but much wider; and, in the male, instead of presenting transversal grooves for the lodgment of the intromissive organs, which in the genus last-named come out at the base of the posterior feet, it is itself perforated at a distance from the border to give a direct passage to these appendages of the spermatic conduits. The disposition of the feet is nearly the same as in *Gonoplax*.

M. transversus. Length about ten lines; some hairs on the feet.

It has been taken at Pondichéry. (Milne-Edwards.)

Cleistotoma (De Haan).—Front much wider than in *Macrophthalmus*, occupying about the third of the anterior border of the carapace, and a little inclined; ocular peduncles large, and of moderate length; orbits of the ordinary form; buccal frame at least as wide in front as behind; third joint of the external jaw-feet nearly of the same size as the second, and nearly square; anterior feet short in the two sexes.

C. Leachii. Carapace smooth and hairless; hands (manus) very large in the male; thighs granulous above. Length four lines.

It is found in the Red Sea.

M. Milne-Edwards thinks that *Ocypode* (*Cleistotoma*) *dilatata* (De Haan, 'Fauna Japonica,' Crust., pl. vii. fig. 3), the figure only of which is published, comes very near to *C. Leachii;* and he is also of opinion that the crustacean figured by M. Savigny, pl. ii. no. 2, and designated by M. Audouin as *Macrophthalmus Boscii* might be referred to this genus. M. Milne-Edwards however had not examined the buccal apparatus.

Fossil Gonoplacidæ.—M. Desmarest ('Hist. Nat. des Crustacés Fossiles') enumerates the following Fossil species of the genus *Gonoplax*, Leach:—*G. Latreillii*, generally incrusted in an argillaceous, grayish, rather hard limestone, which does not soften in water (calcaire argileux grisâtre assez dur, et qui ne se délaie pas dans l'eau); from the East Indies. *G. incisa* (*Cancer lapidescens* of Rumphius), incrusted in a gray, calcareous, argillaceous, and sandy stone; from the Indies, rather frequent. *G. emarginata* in an argillaceous, sandy, calcareous stone, of a yellowish-gray; frequent in collections, and noted as coming from the East Indies. *G. impressa*, approaching very near to the other species from the East Indies in its colour and in the incrusting stone, whence M. Desmarest is much inclined to think that it came from the same stratum. At the same time he says, that it should be stated that the specimen came to him from the Muséum d'Histoire Naturelle in a wrapper marked 'From Mount Marius, at Rome.' *G. incerta*, locality not mentioned; the specimen belonged to the Marquis de Drée.

M. Milne-Edwards observes, that the last-mentioned species, which is referred by M. Desmarest to the genus *Gonoplax*, approaches the recent species in form, and may well belong to the group; but its carapace is square instead of trapezoidal, and the lateral borders are not arched. M. Milne-Edwards is further of opinion that the greater part of the Fossil *Gonoplacidæ* described by M. Desmarest ought to be referred to the genus *Macrophthalmus* rather than to *Gonoplax*, for the form of their front, and even that of the carapace in general, is entirely that of the *Macrophthalmi*, and differs remarkably from the shape of the same parts in *Gonoplax;* and he records the following species:—*Macrophthalmus Latreillii* (*Gonoplax Latreillii*, Desm.); *M. incisus* (*Cancer lapidescens*, Rumph.; *G. incisa*, Desm.); *M. emarginatus*, Desm. Of *G. impressa* M. Milne-Edwards remarks that it comes very near the preceding species, but ought not to be referred to the same genus, because its carapace is nearly as long as it is wide, and its anterior feet are very short and convex (renflées).

GONOPLAX, a genus of Brachyurous Decapodous *Crustacea.* One of the species, *G. angulatus*, is found on the British coasts.

GONYOCEPHALUS. [DRACONINA.]

GOODENIACEÆ, *Goodeniads*, a small natural order of Exogenous Plants. The species are herbaceous plants, rarely shrubs, without milk, with simple or glandular hairs, if any are present; leaves scattered, often lobed, without stipules, very rarely opposite; inflorescence terminal, variable; flowers distinct, never capitate, usually yellow, blue, or pink. The calyx is usually superior, rarely inferior, equal or unequal in from three to five divisions. Corolla always more or less superior, monopetalous, more or less irregular, withering, its tube split at the back, and sometimes capable of being separated into five pieces. When the calyx only coheres with the base of the ovary, its limb 5-parted with one or two lips, the edges of the segments being thinner than the middle, and folded inwards in æstivation. Stamens 5, distinct, alternate with the segments of the corolla; anthers distinct or cohering, 2-celled, bursting longitudinally; pollen simple or in fours; ovary 1- or 2-celled, rarely 4-celled, with definite ovules. The fruit a 1-, 2-, or 4-celled capsule, with many solitary or numerous seeds attached to the axis of the dissepiment, which is usually parallel with the valves, rarely opposite to them. The great


2 1 3

Goodenia ovata.

1, a front view of a corolla; 2, the ovary with the stamens, style, and cupule surrounding the stigma; 3, the ovary with the superior calyx.

peculiarity of this order resides in the stigma, which is seated at the bottom of a cup or covering called an indusium; unknown in Bellworts or Lobeliads, to which the genera might otherwise be referred. It is of the same nature as what is found in Brunoniads and Styleworts, and is to be regarded as nothing more than a remarkable exaggeration of the rim which surrounds the stigmatic surface of Heathworts, and of the plates which cover the style of Cranesbills and Balsams. These plants belong to Australia and the islands of the Southern Ocean, or only advance into India in the form of a *Scævola.* There are 14 genera and 150 species. The order is allied to *Lobeliaceæ* and *Stylidiaceæ*.

GOODYERA, a genus of Plants belonging to the natural order *Orchidaceæ*, and the tribe *Limodoreæ.* It has a ringent perianth; the lips entire, included, saccate at the base; the stigma rostellated, subcordate; the rostellum erect, bipartite, with a large squarish appendage between its slender segments. One species of this genus, *G. repens*, is found in Scotland. It has a stem 6 to 8 inches high, with the radical leaves ovate, stalked, reticulated, and the whole upper part of the plant covered with minute stalked glands. It is found principally in fir-forests. (Babington, *Manual.*)

GOOSANDER. [DUCKS.]

GOOSE. [DUCKS.]

GOOSEBERRY. [RIBES.]

GOOSE-GRASS. [GALIUM.]

GORAL. [ANTILOPEÆ.]

GORE-BILL. [BELONE.]

GORGONIA, a genus of Animals belonging to the order *Polypifera*, and the type of the family *Gorgoniadæ.* It has the following generic characters:—Polype-mass rooted, arborescent, consisting of a central axis backed with a polypiferous crust; the axis horny, continuous, and flexible, branched in co-equality with the polype-mass; the crust when recent soft and fleshy, when dried porous and friable; the orifices of the polype-cells more or less protuberant. The species of *Gorgonia* thus defined are not numerous. Dr. Johnston enumerates four species as being found on the British coasts.

G. verrucosa, the Warted Sea-Fan, is somewhat fan-shaped, much and irregularly branched, the branches cylindrical, flexuous, backed when dry with a white warted crust; segments of the cells unequal.

obtuse. This polype is found abundantly on the whole of the south coast of England. It lives in deep water.

G. pinnata, branched and pinnated, the branches compressed; polype-cells in regular rows on each margin, mammillate, unarmed. This species was dredged by Professor E. Forbes and Mr. M'Andrew in the sound of Skye, where they found it attached to stones in 30 fathoms water.

G. placomus, irregularly branched, the branches disposed in a dichotomous order and a flattish form, cylindrical, warty; cells protuberant, conical, surrounded at top by little spines. This is the Warted Sea-Fan of Ellis, and is found on the Cornish coast, but is rare.

G. anceps, the Sea-Willow of Ellis. It is branched, sub-dichotomous; branches with the flesh flat on each side, with a row of little mouths along both the margins. This is a rare species. It was found originally by its describer Mr. Dale, near Margate. It is of a violet colour when fresh. It is a doubtful native of our seas.

G. flabellum has been found on British coasts, but it has been undoubtedly accidental.

(Johnston, *British Zoophytes.*)

GORLANDITE. [LEAD.]

GORSE. [ULEX.]

GOSHAWK. [FALCONIDÆ.]

GOSSY'PIUM, a genus of Plants belonging to the natural order *Malvaceæ*, common to both the Old and New World, and which, from the hair, or cotton, enveloping its seed being so admirably adapted for weaving into cloth, is, after those affording food, one of the most important groups of plants. There can be no doubt that it is indigenous in America, as, besides the distinctness in species, specimens of cotton still attached to the seeds, as well as cloth fabricated from the former, have been brought by Mr. Cumming from the Peruvian tombs. Some of the cloth, consisting of chequered squares of black and white, very nearly resembles some modern patterns. Humboldt has moreover stated that it formed the only clothing of the natives of Mexico, and is one of the plants they most anciently cultivated. With respect to the Old World, the almost universal use of cotton as clothing in the East is well known; and as the species, so far as ascertained by botanists, appear to be Indian and Chinese, the historical investigation is interesting as proving an early communication between the civilised nations of remote antiquity. Though Rossellini incorrectly states that cotton was employed as mummy-cloth, it must have been known to the ancient Egyptians, as he found some of the seed in one of the monuments of Thebes. In later times, we learn from Arrian that muslin was exported from India to the Arabian Gulf, and from that country cotton was no doubt first made known to the rest of the world.

The Sanscrit name of the Cotton-Plant is 'karpasi,' and the Hindoo 'kupas;' the cotton itself is in the latter language called 'rooi.' The former is interesting, as 'karpasus' occurs in the 'Periplus' of Arrian, and is rendered by Dr. Vincent 'fine muslin.' It is derived from the Sanscrit 'karpasi,' from which probably, as indicated by the editor of 'Harris's Dictionary,' the Hebrew word 'karpas,' employed in the book of Esther (chap. i. v. 6), is also derived; so likewise the Latin 'carbasus.' Dr. Royle, in his 'Essay on the Antiquity of Hindoo Medicine' (note, p. 145), infers, that as in the above passage of Esther, white, green, and blue hangings fastened to pillars of marble are described in the court of the garden of the king's palace; the practice appears similar to what is now adopted in India, where calico curtains, usually in red and white stripes, and stuffed with cotton (commonly called 'purdahs'), are employed everywhere in India, and at Delhi even in the king's hall of audience. This consists of colonnades of pillars supporting a light roof in the court before the private apartments of the palace. On the outer rows of pillars these purdahs are suspended; hence, the author infers, we may understand the use to which were applied the rows of pillars in front of the palace in the ruins of Persepolis.

Cotton was no doubt in later times cultivated and manufactured into cloth. Pliny (lib. xix. c. 1) states that Upper Egypt produces a small shrub which some call 'gossypion,' others 'xylon,' bearing fruit like a nut, from the interior of which a kind of wool is produced, from which very white and soft cloth is manufactured. Had it been common in Egypt in the time of Herodotus, it could not have escaped him; as he says specially of the Indians, that they possess a kind of plant which, instead of fruit, produces wool of a finer and better quality than that of sheep: of this the natives make their clothes. Nearchus describes the dress of the Indians as being made of flax from trees ('Library of Entertaining Knowledge,' Egypt. Antiq., ii. p. 125). Theophrastus (lib. iv. c. 9) clearly describes the cotton with leaves like the vine as being abundant in the Island of Tylos in the Persian Gulf. Heeren, in his work on the 'Commerce of the Ancients,' comes to the conclusion that these plantations of cotton in the Island of Tylos were the result of the commerce with India, the true country of the cotton. The inferences from these quotations of the original introduction of cotton from India into Egypt are in some measure confirmed by there being no species of *Gossypium* indigenous and peculiar to the latter country. In conclusion, it is necessary to refer to the facility with which cotton is distinguished from linen to controvert the assertion of Rossellini that it was always employed for mummy-cloth; as the result of numerous observations by Bauer, &c., with the most powerful microscopes of modern times, and every variety of mummy-cloth, has proved that it is invariably composed of linen, and not of cotton cloth. The one fibre is easily distinguished from the other; that of cotton having a flat tape or riband-like appearance, while the fibre of the linen has a round tubular and even-jointed structure. (Egypt. Antiq., 'Library of Entertaining Knowledge,' vol. ii. p. 182.)

The genus *Gossypium* is characterised by having a double calyx, of which the inner is cup-shaped, obtusely 5-toothed, the outer or involucre tripartite, with the leaflets united at the base, cordate, with the margins irregularly cut. Stigmas, 3-5. Capsules, 3- or 5-celled, many-seeded. Seeds clothed with wool-like hairs, or cotton.

The species of *Gossypium* occupy naturally a belt probably exceeding the torrid zone in breadth, but in a cultivated state we have cotton now extending on one hand to the south of Europe, and Lower Virginia and even Maryland in the United States of America; while on the other we have it as far south as the Cape of Good Hope, and in America to the southern parts of Brazil. Within these limits it may also be seen cultivated at considerable elevations. Baron Humboldt mentions having seen it even at 9000 feet of elevation in the Equinoctial Andes, and in Mexico at 5500 feet. Dr. Royle states that it is cultivated in small quantities at 4000 feet of elevation in 30° N. lat. in the Himalayas. The localities suited for the production of cotton depend as much upon the climate as the soil, and also upon the specific peculiarities of the different kinds of cotton plants. That the production of cotton is so much influenced by external circumstances is not more remarkable than in many other cultivated plants; indeed, we might expect it to be more so from the susceptibility of this hairy development to the influence of situation. Humboldt has remarked that *G. Barbadense*, *G. hirsutum*, and *G. religiosum* flourish in a climate where the mean annual temperature is from 82° to 68°; but that *G. herbaceum* is successfully cultivated where, the summer heat being 75° or 73°, that of winter is not less than 46° or 48°. The cultivation of this cotton however does not depend so much on winter cold as on sufficient length of suitable summer heat. The thermometer in Upper Virginia is sometimes as low as zero of Fahrenheit in winter, and yet cotton can be cultivated during the long summer.

It is remarkable that a genus so important for its product, and so long known, and with comparatively so small a number of species, should yet have these undetermined. The celebrated De Candolle states, that no genus more urgently requires the labours of a monograph from a careful botanist who could have the opportunity of seeing the species in a living state. The confusion has in a great measure proceeded from botanists absurdly neglecting the cultivated in their search for new species; and cultivators being incompetent or unwilling to distinguish varieties from species, frequently raising the former to the rank of the latter, because the produce, in which alone they are interested, happened to be more or less valuable. In the proceedings of the East Indian Committee there is an interesting letter from Mr. Spalding, where he informs us that the American cultivators confine their attention to such plants as are of annual growth. 1st. The Nankeen Cotton, introduced at an early period. This is abundant in produce; the seed covered with down, the wool of a dirty yellow colour, and usually low priced. 2nd. The Green-Seed Cotton with white wool, which, with the former, is grown in the middle and upland districts, whence the latter is called Upland Cotton, also Short Staple Cotton, and, from the mode in which it was cleaned, Bowed Georgia Cotton. 3rd. The Sea-Island or Long Staple Cotton, which is distinguished by the black colour of its seed, and by the fine, white, strong, and silky long staple by which it is surrounded. This is grown in the lower parts of Georgia and South Carolina, near the sea, and on several small islands which are not very distant from the shore.

The species admitted by botanists are not yet clearly determined. M. De Candolle admits 13 species, and notices others. Two have since been described by Dr. Roxburgh, one by Rœusch, and another in the 'Flore de Senegambie.' Of varieties Mr. Bennett says he knows more than one hundred kinds, and that they appeared to him never-ending. Dr. Royle, the most recent author who has treated expressly of the species, admits eight species, in which are absorbed some of De Candolle's; while others are avowedly unnoticed for want of materials for satisfactory determination. But from his own observations, Dr. Roxburgh's 'Flora Indica,' as well as from Swartz, 'Observ. Bot.' for the West Indies, and the specimens, though few, in the British Museum, it is probable that several of the cultivated species are correctly determined.

G. herbaceum (Linn.), which is herbaceous in temperate, and usually with bi-triennial stems 4-6 feet high in tropical countries, is no doubt the *Xylon* s. *G. antiquorum*, and includes also the *G. Indicum* of Lamarck, which would indeed be the preferrible name for this species. The younger parts of the stem, as well as the flower- and leaf-stalks, hairy and marked with black spots. Leaves hairy, palmate, 3- (generally) 5-lobed, lobes broad and rounded with a little point, or in the woody varieties sub-lanceolate and acute. Stipules falcate, lanceolate. Flowers of a lively yellow colour, with a purple spot near the claw. Segments of exterior calyx dentate, sometimes entire. Capsules ovate, pointed, 3- or 4-celled. Seeds free, clothed with finely-adhering grayish down under the short-staple white wool.

This and its varieties are those chiefly cultivated in India. It has been procured from China and the Malayan Peninsula, and also from Egypt. *G. punctatum*, from Senegambia, is probably a variety. It is that cultivated in the Mediterranean region, and must have been the species taken to America from Smyrna.

G. arboreum, Linn. Stem arboreous, 15-20 feet, sometimes shrubby, young parts hairy, tinged of a reddish colour. Leaves palmate, 3- or 4-lobed, hairy, dotted with blackish spots of a dark green colour; lobes elongated, lanceolate, sometimes mucronate, sinus obtuse, glands one, sometimes three. Stipules oval-shaped. Flowers solitary, with short peduncles, red, with a yellowish tinge near the claws. Leaflets of the exterior calyx cordate, ovate, entire, sometimes dentate. Capsule ovate-pointed, 3- or 4-celled, seeds covered with a greenish-coloured fur, enveloped in fine silky yellowish-white wool. This species is found in the island of Celebes and in every part of India. It is noticed among lists of the plants of Arabia, and also of Egypt. It is planted near temples and habitations of Faqueers in India, and is stated to be sacred to the Hindoo deities, and therefore employed only for making muslin for turbans. The species is marked *G. religiosum* in Heyne's 'Herbarium,' and one specimen of *G. Barbadense* is marked *G. arboreum* in the 'Linnean Herbarium.'

G. religiosum. Perennial. Stem 3-4 feet, branches and petioles a little velvety, hirsute towards the apex, and covered with black points. Leaves cordate, superior 3-lobed, inferior 5-lobed, deeply divided; lobes ovate-acuminate, entire, pubescent (some of the lower ones ovate-acuminate), one to three glands; stipules lanceolate, deciduous (cordate-acuminate, Roxb.). Flowers large, fulvous, peduncles short, dotted; leaflets of the exterior calyx large, cordate-acuminate, deeply laciniate, hairy and dotted; capsule ovate-acuminate, dotted, 3- 4- or 5-celled; seeds black, covered with firmly-adhering short tawny fur under the long tawny-coloured wool.

Gossypium Barbadense.

1, branch with full and half-blown flowers; 2, capsule burst open, showing the cotton in three divisions corresponding with the cells of the capsule; 3, a seed enveloped with cotton.

There is considerable confusion with respect to the species which should be called *G. religiosum*. The distinguishing characteristic of what is considered such at present is the having tawny-coloured instead of white wool. There are at least two distinct localities for this kind of cotton, one Siam, the other China. From the latter country it was introduced both into India and America under the name of Nankin Cotton. Dr. Royle is of opinion that two distinct species yield tawny-coloured cotton; one with small velvety-looking leaves and much dotted in every part, of which he has seen specimens from Macao, Tahiti, and Guzerat. The other is a much larger plant, with the general appearance and leaves of *G. Barbadense*, of which there are specimens in the 'East Indian Herbarium.' Mr. Wilkinson has brought specimens from Egypt of a rather tawny-coloured cotton, with brownish seed, free from fur, which he says is there called 'gotun Hindeo.'

G. hirsutum, Linn. Shrubby, about six feet high, young pods very hairy. Leaves, the upper undivided, cordate, acute; the lower 3- or 5-lobed; lobes ovate, acute (triangular, Roxb.), hairy on the under and smooth on the upper surface. Petioles very hairy, dotted with black spots; glands 1 or 2 to 3; stipules lanceolate (Cavanilles); corolla, base yellow, purplish towards apex (uniform yellow, Roxb.); exterior calyx ovate-acute, very hairy, cordate, 3-toothed (Cav. laciniate, Roxb.); capsule large, ovate-acute; seeds many, free, clothed with firmly-adhering green down under the fine long white wool. (Swartz.) This species is cultivated in Jamaica, according to Swartz; and would appear, from the description of the seed, to be the Green-Seeded, Short-Staple, or Upland Cotton of the Americans.

G. Barbadense. Stem shrubby, 6-15 feet, smooth; leaves, the upper 3-lobed, the lower 5-lobed; lobes ovate, acute, smooth, often pubescent on the under surface; leaflets of exterior calyx large, deeply laciniate; flowers yellow; capsule ovate, acuminate, smooth; seeds 8-12, free, oblong, black, and without any other pubescence than the long fine easily-separable cotton. Swartz describes this species as extensively cultivated in the West Indies: it is also the *G. vitifolium* of Cavanilles. It is one of the cultivated cottons of Egypt.

It is more than probable that the Sea-Island or Long Staple Cotton is a variety of this species, as its seeds agree in character. More than this it is not possible to say, as, among the numerous collections which London contains, strange to relate, there are none in which genuine specimens of cultivated cottons, properly named, can be seen; but it is to be hoped that travellers and naturalists will be induced to pay a little more attention to the products of a country, whether natural or the result of art, and deposit them in our museums, with the plants which produce them.

Several other species, as *G. punctatum*, from Senegal; *G. obtusifolium*, from Ceylon; and *G. Peruvianum*, from Brazil, have been described; but Dr. Royle is of opinion that all the species of cotton may be reduced to four—*G. Peruvianum* (*G. acuminatum*); *G. Indicum* (*G. herbaceum*); *G. arboreum*; and *G. Barbadense*.

For further information the reader is referred to the works quoted above, and to Royle's 'Illustrations of the Botany, &c., of the Himalayan Mountains.' [COTTON, in ARTS AND SC. DIV.]

GÖTHITE, a Mineral, to which also the name *Lepidokromite* is given. It is a hydrous peroxide of iron, differing from the brown iron-ore by containing half as much water. The crystals are of a brown colour, and blood-red by transmitted light when sub-transparent. It has a hardness of 5; and its specific gravity 4 to 4·2. It is found with hæmatite at Eiserfeld in Nassau, at Clifton in Cornwall, also in Siberia. *Turgite*, from the Ural, seems to be identical.

GOUR. [BOVIDÆ.]

GOURD, a kind of fruit obtained from various plants of the natural order *Cucurbitaceæ*. In countries having hot and dry summers the different kinds of this fruit are held in high estimation, and are a valuable article of consumption, acquiring a very large size, abounding in nutritious matter, and being moreover very wholesome. The largest is the kind called Potiron Jaune by the French, which sometimes weighs above 2 cwt. All the most esteemed kinds belong to the genus *Cucurbita*, the species of which are almost entirely destitute of the bitterness that renders other fruits of the same natural order unfit for food: thus the Vegetable Marrow is supplied by the *Cucurbita ovifera*; the Potiron by *C. maxima*; the Squash-Gourd, a very delicate sort, and perhaps the most agreeable of all when cooked in a very young state, by *C. melopepo*; and the Orange-Gourd by *C. aurantia*. Bottle-Gourds, which are bitter and dangerously drastic, are the fruit of *Lagenaria vulgaris*; while what is called the Colocynth-Gourd, a powerful purgative, is in reality a kind of melon, the *Cucumis colocynthis*. [CUCURBITACEÆ.]

GOWDIE, a name for the fish called the Sword Dragonet. [CALLIONYMUS.]

GOWDNOOK. [SCOMBERESOX.]

GRACILLARIA. [ALGÆ; RHODYMENIACEÆ.]

GRACULA. [CORACIAS.]

GRAINING. [LEUCISCUS.]

GRAINS OF PARADISE are hot, acrid, aromatic seeds, produced upon the coast of Guinea, and used for medicinal and other purposes as stomachic and cordial stimulants. They are produced by the *Amomum Grana Paradisi* of Linnæus, and *Amomum grandiflorum* of Smith. [AMOMUM.]

GRALLÆ (Wading-Birds), the fourth order of the class *Aves*, according to Linnæus, and placed by him, in his last edition of the 'Systema Naturæ,' between the orders *Anseres* (the third) and *Gallinæ* (the fifth).

Linnæus thus characterises the *Grallæ*:—Bill (a sounding staff, 'bacillus tentans') subcylindrical. Feet wading, the thighs half naked. Body compressed, the skin very thin, sapid; the tail short. Food, consisting of animalcules, obtained in marshes. Nest most frequently made on the ground; sexual congress varying ('nuptiis variis'). Analogous to the *Bruta*.

The same author divides the order into two sections:—

* Feet four-toed.

Phœnicopterus, Platalea, Palamedea, Mycteria, Tantalus, Ardea, Recurvirostra, Scolopax, Tringa, Fulica, Parra, Rallus, Psophia, Cancroma.

** Feet cursorial, that is, 3-toed.

Hæmatopus, Charadrius, Otis, Struthio.

In the body of the work Linnæus gives the following definition of the *Grallæ*:—Bill subcylindrical, rather obtuse. Tongue entire, fleshy. Thighs naked above the knees. [GRALLATORES.]

GRALLATORES (Illiger), the fourth order of Birds according to the system of Mr. Vigors, the *Rasores* being the third, and the *Natatores* the fifth.

Mr. Vigors considers the *Grallatores* as one of the aberrant groups of the class, and as exhibiting an equally circumscribed sphere of action as the *Rasores*. Holding an intermediate station between the Gallinaceous Birds, which are restricted to the land, and the Natatorial groups, which are confined to the water, their typical groups appear to Mr. Vigors to be those which partake most equally of the advantages of both elements; and the aberrant groups those which discover a more predominant inclination to either. "Of the five families," continues Mr. Vigors, "into which the order before us branches out, we may, in this point of view, pronounce those two to be most typical which inhabit the land, but derive their support from the water, or, to speak more correctly, which derive their whole support from the latter element, without possessing those powers of swimming or diving which are peculiar to the true water-fowl. The exclusive food of such groups will be fish, water reptiles and insects, *Mollusca*, and animalcules; and their distinguishing external characters, length of legs and bill, the former for the purpose of wading, the latter for that of seizing their prey, or of extracting it by suction from the waters or marshes. Of the three remaining families, two, as I have observed in an early part of this inquiry, will be found to deviate from the more typical, in their food and manners being more terrestrial, and their general appearance and structure more conformable to that of some groups of the preceding order of *Rasores*: while the third, by its capability of swimming and the rudiments of the natatorial membrane that connects the fore toes of some of its species, equally deserts the same type, and goes off, on the other hand, to the *Natatores*. Taking these peculiarities into consideration, we may venture to view the order according to the following arrangement, placing, as usual, the more typical families in the centre:—

Gruidæ.
Ardeidæ, Leach.
Scolopacidæ.
Rallidæ, Leach.
Charadriadæ, Leach.

"The following disposition distinguishes the normal and aberrant families:—

Normal Group.

Bills long, principally fitted for suction . . { *Ardeidæ.* *Scolopacidæ.*

Aberrant Group.

Bills short, and fitted for capturing, not sucking { *Rallidæ.* *Charadriadæ.* *Gruidæ.*"

The species that enter into the different families are noticed in the articles which treat of them, as well as the mode of union between one family and another.

Mr. W. S. M'Leay, in his paper 'On the Comparative Anatomy of Certain Birds of Cuba,' observes that the relations of analogy pointed out by Linnæus between *Mammalia* and Birds are, as Hermann has observed, not always correct; and that his errors have arisen from the misfortune of his not detecting the natural group of Aristotle and Ray, which the latter has called *Ungulata*. "Having," says Mr. M'Leay, "only been able to seize Aristotle's subdivisions of Τὰ μὲν οὐκ ἀμφοδόντα, he lost the parallelism of analogy, and fell, as I shall hereafter show, into very glaring mistakes. In the 'Systema Naturæ' however he has mentioned that very striking analogy which appears between the groups of *Grallæ* and *Bruta* [GRALLÆ], that is, according to the parallelism of analogy, between the order of *Grallatores* and *Ungulata*, since the *Bruta*, as we have seen, do not form an order, but only a natural subdivision of the *Ungulata*. That this analogy is demonstrably true, I deduce from the following facts. Of their respective classes, the orders of *Ungulata* and *Grallatores* contain examples of the longest legs in proportion to the body—witness *Camelopardalis* and *Hæmantopus* (*Himantopus* of authors?). Both orders present us, in groups not exactly aquatic, with instances of the toes being soldered together, as the Horse; or connected together with a web, as the Flamingo. Both orders present us with the greatest elongation of muzzle or facies—witness *Myrmecophaga* [ANT-EATER], or *Antilope* (particularly *A. Bubalus*) [ANTILOPEÆ], and *Scolopax*; and also with the most depressed form of muzzle—witness *Hippopotamus* and *Platalea*, which genera also afford us the truest specimens of wading *Vertebrata*. In both orders we have the most elongated claws—witness *Megalonyx* and *Parra*. Both orders afford us the swiftest animals in running—as the Horse and *Tachydromus*; and the most pugnacious on account of love—as the Bull and *Machetes*. The Bull moreover and the *Butor* (or *Bostaurus*, for hence comes the bird's name) [BITTERN], afford us the loudest and hoarsest voice of their respective orders; where we have also the most remarkable instances of the upper and under mandible touching each other merely at their base and point, as *Myrmecophaga*, or the whole of the Τὰ μὲν οὐκ ἀμφοδόντα of Aristotle, and *Anastomus*, Illig. Both orders exhibit ornamental appendages to the head—as the antlers of the Stag and the crown of the Crane; and both afford us the only instances of true horns, as *Bos*, or *Rhinoceros*, and *Palamedea*, Linn. To see a hundred such instances of resemblance it is only necessary to walk into a museum. I shall therefore only further say, that both orders contain polygamous animals, are generally gregarious, and more graminivorous than granivorous, being essentially inhabitants of marshes and savannahs. Thus then with Linnæus I place the *Bruta*, or rather the whole order of *Ungulata*, to which they belong, opposite to the *Grallatores*."

Mr. M'Leay then proceeds to observe that four orders in each class being disposed of, it follows by parallelism of analogy that the *Glires* ought to be placed opposite to the *Rasores*. But he asks, setting theory wholly aside, is this position true in fact? Linnæus, he remarks, from the above-mentioned error in his series of affinity considered the *Rasores* to be analogous to his group of *Pecora*. But this group, according to Aristotle and Ray, is only a subdivision of *Ungulata*, which have, Mr. M'Leay considers, been now proved to be analogous to the *Grallatores*. If therefore, he concludes, Linnæus be right in making his *Bruta* analogous to the order of Wading Birds, it follows that his *Pecora* must be so also.

In the same paper therefore Mr. M'Leay gives the following tables of analogies between the *Mammalia* and *Aves*:—

	Animals typically	
1. *Feræ*	carnivorous	1. *Raptores.*
2. *Primates*	omnivorous	2. *Insessores.*
3. *Glires*	frugivorous	3. *Rasores.*
4. *Ungulata* .	frequenting the vicinity of water .	4. *Grallatores.*
5. *Cetacea*	aquatic	5. *Natatores.*

Scansores.	Insessores.	Aves.
Psittacidæ representing the .	*Dentirostres*, and therefore the . . .	*Raptores.*
Rhamphastidæ joining the .	*Conirostres*, and forming part of the	*Insessores.*
Cuculidæ forming part of the	*Scansores*, and joining the	*Rasores.*
Certhiadæ joining the	*Tenuirostres*, and representing the .	*Grallatores.*
Picidæ representing the . . .	*Fissirostres*, and therefore the . . .	*Natatores.*

The latter table, Mr. M'Leay observes, will express several analogical relations of the utmost value, and the reader will find them fully explained in Mr. M'Leay's memoir. ('Linn. Trans.,' vol. xvi. p. 1.)

Mr. Swainson ('Classification of Birds,' vol. i.) remarks, that the grallatorial or tenuirostral type is shown in birds, as in quadrupeds, by a great slenderness and elongation of the jaws, muzzle, or bill—for all these, he states, are merely different terms to express nearly the same thing; "The notch in the bill, when it exists, is very slight, and the feathers of the front are considerably advanced upon the base of the upper mandible. The opening of the nostrils is very long, often tumid, but never round. Great swiftness either of foot or of wing is a constant indication of this type. Sometimes, as in the Snipes, both these characters are united; at other times, as we see in the Humming-Birds, this swiftness is confined only to flight; while in some few, as in the Flamingo, the wings are short, but the feet very long. The aperture or gape of the mouth is generally very small, as in all suctorial animals,—witness the whole of the typical *Grallatores*, or Waders, and their representatives the *Trochilidæ*. The smallest birds, no less than the smallest quadrupeds, are of this type, which is again represented by the little gliriform *Mammalia*."

Mr. Swainson gives, in the same volume, the following table of analogies:—

Primary Types.	Orders of Birds.	Typical Characters.	Orders of Quadrupeds.
1. Typical	*Insessores*	Organs of prehension and general structure highly developed.	*Quadrumana.*
2. Sub-typical	*Raptores*	Carnivorous; claws retractile.	*Feræ.*
3. Aquatic	*Natatores*	Live and feed in the water; feet very short or none.	*Cetacea.*
4. Suctorial	*Grallatores*	Jaws much prolonged; burrow for their food.	*Glires.*
5. Rasorial	*Rasores*	Head with crests of horn or feathers; habits domestic; feet long, formed for walking.	*Ungulata.*

Mr. Swainson considers that "these analogies are so perfect, and the series so completely in unison with those of all other animals," that he deems it unnecessary to go into any long details.

In further support of the relation between the *Grallatores* and *Glires* insisted on also in the 'Natural History and Classification of

Quadrupeds,' Mr. Swainson adverts to the elongation of the upper jaw or mandible of these animals, a peculiarity which is more conspicuous, he says, in them and their representatives than in any other groups. "If," continues Mr. Swainson, "we examine, for instance, the bill of the woodcock family, we find that its termination in regard to the contour gives an almost ludicrous resemblance to the muzzle of a rat, particularly if we fancy that both were of the same size. Now it is perfectly clear, that as these two animals when feeding generally insert their muzzle in the ground, so there can be no doubt that this particular formation is essential to that propensity. The only quadrupeds, again, which have the snout inclining upwards, are of the gliriform type; and the only birds in which the bill takes the same direction are typical of the *Grallatores*. The *Sorex*, *Dasypus*, &c., are all types of the gliriform quadrupeds, as those of *Trochilus*, *Avosetta*, *Tringa*, are of the grallatorial structure in birds: so that the resemblance of the snout of *Nasua* and *Avosetta* are as like as it is possible, considering that one is a quadruped and the other a bird. To the same type also belongs the *Echidna*, or Porcupine Ant-Eater, the American genus *Myrmecophaga*, and the Indian *Manis*: all these are pre-eminently characterised by that great prolongation of muzzle which constitutes, as before mentioned, one of the chief characters of the type we are now illustrating." We have given Mr. Swainson's own words, that the reader may have an opportunity of forming his own opinion as to the premises and conclusion; and we must further add, with reference to this volume, that Mr. Swainson considers that the typical structure of the wading foot "is found in the Sandpipers (*Tringa*), Tatlers (*Totanus*), and Snipes (*Scolopax*)."

In the second volume of 'The Classification of Birds,' we find that Mr. Swainson considers that the families under which the Waders are naturally arranged are these:—"1, the *Ardeadæ*, or Herons; 2, the *Charadriadæ*, or Plovers; 3, the *Tringidæ*, or Sandpipers; 4, the *Rallidæ*, or Rails; 5, the *Tantalidæ*, or Ibices (Ibises)." Mr. Swainson is of opinion that the 2nd and 3rd are the typical groups. In the same volume, farther on, we find the families of the *Grallatores* in the following order:—*Ardeadæ*, *Tantalidæ*, *Rallidæ*, *Scolopacidæ*, *Charadriadæ*, and at pages 28, 32, &c., will be found other analogical tables and explanations regarding the order.

Fossil Grallatores.

The fossil remains of the families of this order will be noticed under the articles which treat of them. But we may here state that the remains of Wading Birds occur in various strata. For instance, in the gypsum of the Paris Basin (Tertiary—Eocene period of Lyell) the bones of birds referrible to the genera *Scolopax*, *Tringa*, and *Ibis* have been found; and, in the fresh-water formation of Tilgate Forest (secondary series) Dr. Mantell found the remains of a Wader larger than a common Heron. But this bird must have been a pigmy when compared with those gigantic Waders (apparently) whose footsteps Professor Hitchcock records as being preserved in the new red-sandstone of the valley of the Connecticut. The professor refers these fossil footsteps to at least seven species of *Grallatores* with very long legs, and ranging from the size of a snipe to twice the dimensions of an ostrich.

These footmarks, which Professor Hitchcock names *Ornithichnites*, were found at various depths beneath the actual surface in quarries of laminated flagstones, at five places near the banks of the river, within a distance of 30 miles. The inclination of the sandstone is from 5° to 30°, and the tracks appear to have been made on it before the strata were so inclined. Seven of these tracks, which the professor figures, are considered by him to have been made by seven different species, if not genera. The footsteps appear in regular succession on the continuous track of an animal in the act of walking or running, with the right and left foot always in their proper places. There is occasionally a variation in the distance of the intervals between each footstep on the same track, but to no greater amount than the alteration of its pace by the bird would explain. Many tracks of different individuals and different species are often found crossing each other, and the footsteps are sometimes crowded together in the same manner that impressions of the feet of ducks and geese are left on the muddy shore of the stream or pond where they resort. The professor remarks, however, that none of the footsteps appear to be those of web-footed birds; they most resemble, he states, those of *Grallæ* (Waders), or birds whose habits resemble those of *Grallæ*. The impressions of three toes are usually distinct, except in a few instances; that of the hind toe is mostly wanting, as in the footsteps of modern *Grallæ*. But we must now draw the reader's attention to the most remarkable among these footmarks, hitherto found in one quarry only, at Mount Thorn near Northampton, where were discovered four nearly parallel tracks of a gigantic bird, whose foot measured 15 inches in length, exclusive of the largest claw, which was 2 inches in length. All the three toes were broad and thick. In one of the tracks a regular succession of six of these enormous footsteps appeared at a distance of 4 feet from each other; in others the distance varied from 4 to 6 feet, and it is supposed that the latter was the longest step of this bird-giant whilst it was running.

The footsteps next to be noticed are those of another enormous bird, whose toes were however more slender than those of the last (*Ornithichnites giganteus*), but measured from 15 to 16 inches in length, exclusive of a remarkable appendage extending backwards from the heel 8 or 9 inches, and apparently intended to sustain the animal when walking on a soft bottom. The impressions of this appendage bear a resemblance to those of wiry feathers or coarse bristles, which appear to have sunk into the mud and sand nearly an inch deep; but the toes had sunk much deeper, and the mud was raised into a ridge several inches high round their impressions, similar to the elevation round the track of an elephant in clay. Six feet sometimes seem to have made the length of this bird's stride. Other tracks indicate shorter steps; and the smallest impression tallies with a foot of only an inch long, with a step ranging from 3 to 5 inches. It is to be noted that in every track the length of the step increases with the size of the foot, and is much longer than the steps of any known existing species of birds. A greater length of leg is thence inferred than that of modern Wading Birds; and it is considered that the steps which are 4 feet asunder probably indicate a leg of 6 feet in length.

The margin of shallow water subject to changes of level, and in which sediments of sand and mud were alternately deposited, appears to have been the locality where these ancient birds congregated. The inferred length of limb would have been well adapted for wading in such a place.

The bones of fishes only (*Palæothrissum*) have yet been found in the rock that has transmitted to us these footsteps, "which are of the highest interest to the palæontologist, as they establish the new fact of the existence of birds at the early epoch of the new red-sandstone formation; and further show that some of the most ancient forms of this class attained a size far exceeding that of the largest among the feathered inhabitants of the present world, and were adapted for wading and running rather than for flight."

(*American Journal of Science and Arts*, vol. xxix.; Buckland, *Bridgewater Treatise.*)

GRAMINA'CEÆ, or GRASSES, are a very extensive and important natural order of Endogenous Plants, comprehending many of the most valuable pasture plants, all those which yield corn, such as wheat, barley, and maize, the sole source of colonial sugar in the sugar-cane, and the most fragrant of all plants in the form of Andropogons. Their structure is among the most simple of the perfect forms of vegetation; a stem clothed with alternate leaves whose stalks are universally thin, and constituting as many sheaths to guard the young and rapidly growing shoots, a few rudimentary leaves collected at the ends of the branches of inflorescence, and constituting flowers, a very small number of stamens, and a single seed inclosed in a thin pericarp, are all that nature provides to enable these plants to preserve their race and to distinguish their numerous kinds from one another. Yet, with such a simple apparatus, many thousand species are so precisely characterised that the natural order of Grasses is perhaps one of the easiest to study and arrange, provided the task be commenced upon right principles. The floral leaves, called glumes, paleæ, and scales, offer a prodigious number of different appearances, according to the manner in which they are combined or modified; and the inflorescence, the number of stamens, the texture of the parts, or the relation of the sexes to each other, afford additional means by which the distinctive characters are varied.

This is, no doubt, one of the wise provisions of Providence by which man is enabled to distinguish good from evil, the useful from the useless, the profitable from the unprofitable. For in no class of plants is it more necessary than in grasses to know how to choose between different species. For instance, most grasses are saccharine and nutritious to cattle, but the species of *Holcus*, *Bromus*, &c., are as frequently worthless. There is a great difference between the value of grasses for pasture; certain kinds suit the meadows, others marshes, others upland fields, and others bleak and sterile hills, where they furnish valuable food for sheep: these kinds will not grow indiscriminately, or are not equally suitable for different soils and situations, and it is therefore essential for the husbandman that he should be capable of discriminating between them. Some indicate the quality of soil: the species of *Dactylis*, *Holcus*, and *Bromus* are inhabitants of sterile land; the *Festucæ* and *Alopecuri* of better soil; while various *Poæ* and *Cynosurus* are found only in pasture-land of excellent quality. Most grasses are perfectly harmless, if not nutritious; yet the single species *Lolium temulentum* is a deleterious species in the midst of harmless *Lolia*; and *Bromus purgans* and *Festuca quadridentata* afford similar instances of this singular exception to ordinary rules.

For these and similar reasons, classification, which at all times is so necessary, here becomes the very foundation of all correct knowledge, and it has accordingly very particularly excited the attention of systematic botanists from the time when the general term *Gramen* was broken up by Linnæus into a number of different genera. It is not desirable in this place to show by what degrees the knowledge of botanists upon this subject has advanced from the days of Linnæus up to the present time. Those who are desirous of gaining this information should consult Palisot de Beauvois' 'Agrostographie,' published at Paris in 1812, and the subsequent writings of Brown, Kunth, Nees von Esenbeck, and Trinius. We shall confine ourselves to a general technical description of the order, partly founded upon the 'Agrostographia synoptica' of Kunth, and to brief characters of its tribes as they stand in the 'Genera Plantarum' of Endlicher.

General Character.—Roots in all cases fibrous; stem, called culm by some authors, cylindrical, rarely compressed, varying in length from a few inches, as in *Knappia agrostidea*, to 80 or 90 feet, as in the Bamboo; usually fistular, except at the joints, where it is always solid; sometimes solid throughout, as in the Sugar-Cane; coated with silex, which is also secreted occasionally in lumps in the hollows of the stem under the form of the opalescent substance called 'tabasheer;' in most cases only of annual duration, but sometimes shrubby or arborescent. Leaves one to each node, with a sheathing petiole, the limb membranous, usually narrow; the sheath quite surrounding the stem, slit on one side, usually with a ligula at the apex. Spikelets terminal, panicled, racemose, or spiked; sometimes immersed in the thickened rachis; very seldom several fascicled, or united together, and surrounded by a general spathe. Flowers hermaphrodite, or polygamous, sometimes monœcious, very rarely diœcious, destitute of true calyx or corolla, surrounded by a double set of bracts, the outer constituting the glumes (or calyx of some authors), the inner the paleæ (or corolla of others); all together forming a distichous spikelet of one or more florets. Glumes alternate, the outer usually the largest and most distinctly ribbed, and often having its midrib extended into a beard or awn; sometimes both awned; sometimes the lower glume only present; occasionally both absent; these glumes are only found at the base of the spikelets, and may belong to one floret only or to many. Paleæ usually in pairs, and alternate with each other; the lower and outer 1-3-many-veined, usually keeled, awned or awnless; the upper and inner usually two-veined, more membranous, smaller, awnless, sometimes absent. Hypogynous scales regarded by Kunth as remains of the ligula; by most other botanists as the rudiments of a corolla, usually two on each side of the base of the inner palea; sometimes a third is added in front of the inner palea; sometimes united with each other, sometimes deficient. Stamens hypogynous, usually definite, very rarely indefinite; if six or three, placed all round the ovary; if fewer than three, placed next the outer palea; filaments long and flaccid; anthers versatile, linear, bifid at each end. Ovary solitary, simple, with two styles (rarely three), each having a feathered or branched stigma, one-celled, with a single ovule attached to the pericarp by the whole side, or the lower part of the side next the upper palea. Fruit a caryopsis in most cases, occasionally an utriculus; the pericarp thin and membranous, in the former case adhering firmly to the seeds, in the latter distinct from it. Seed containing a large quantity of floury albumen, on one side of which (that next the lower palea) there lies a lenticular embryo, composed of a thin cotyledon, whose edges are doubled outwards over the plumula and radicle, which therefore press upon the side of the pericarp next the outer palea. The plumula is free, and consists of several sheaths overlying each other; the radicle is composed of several tubercles which break through the sides of the embryo as soon as germination commences.

Under this character M. Kunth assembles about 2500 species, a number far below the real amount, which is probably near 4000, and M. Endlicher 234 genera (now increased to 291), which are classified by the latter botanist as follows:—

Tribe I. *Oryzeæ.*—Spikelets sometimes 1-flowered, with the glumes frequently absent; sometimes 2-3-flowered, with the lower florets consisting of but one palea, and neuter, the upper only being fertile. Paleæ of a stiff papery texture. Flowers often unisexual, usually hexandrous. This tribe includes the following genera:—

Leersia.	*Blepharochloa.*
Potamochloa.	*Oryza.*
Potamophila.	*Hydrochloa.*
Zizania.	*Hygroryza.*
Caryochloa.	*Luziola.*
Ehrharta.	*Tetrarrhena.*
Microlæna.	*Diplax.*
Pharus.	*Leptaspis.*

Oryza.

Tribe II. *Phalarideæ.*—Spikelets hermaphrodite, polygamous, or rarely monœcious; either 1-flowered, with or without a stipitiform rudiment of an upper floret; or 2-flowered, with both florets either hermaphrodite or male; or 2-3-flowered, with the terminal floret fertile, the rest incomplete. Glumes usually equal. Paleæ often shining, hardened in the fruit. Styles or stigmas mostly long. It includes the following genera:—

Lygeum.	*Zea.*
Coix.	*Chionanche.*
Sclerachne.	*Polytoca.*
Cornucopiæ.	*Crypsis.*
Mibora.	*Alopecurus.*
Limnas.	*Beckmannia.*
Phleum.	*Fingerhuthia.*
Chondrolæna.	*Hilaria.*
Phalaris.	*Digraphis.*
Holcus.	*Reynaudia.*
Desprezia.	

Phleum.

Tribe III. *Paniceæ.*—Spikelets 2-flowered, the lower floret being incomplete. Glumes thinner than the paleæ, the lowermost often, occasionally both, being abortive. Paleæ more or less coriaceous or papery, usually awnless, the lower concave. Caryopsis compressed from the back. It includes—

Reimaria.	*Paspalum.*
Milium.	*Amphicarpum.*
Olyra.	*Strephium.*
Thrasya.	*Eriochloa.*
Urochloa.	*Rhynchelytrum.*
Panicum.	*Ichnanthus.*
Bluffia.	*Isachne.*
Stenotaphrum.	*Acratherum.*
Berghausia.	*Melinis.*
Thysanolæna.	*Chætium.*
Oplismenus.	*Berchtoldia.*
Chamærhaphis.	*Pennisetum.*
Setaria.	*Gymnothrix.*
Penicillaria.	*Cenchrus.*
Trachyozus.	*Anthephora.*
Lappago.	*Lopholepis.*
Latipes.	*Echinolæna.*
Navicularia.	*Thouarea.*
Spinifex.	*Neurachne.*

Streptostachys.

Tribe IV. *Stipeæ.*—Spikelets 1-flowered. Lower paleæ rolled inwards, awned at the apex, and usually indurated in the fruit; awn simple or trifid, usually twisted, and articulated at the base. Ovary stipitate. Squamulæ usually three. Under this tribe are included—

Oryzopsis.	*Greenia.*
Piptatherum.	*Lasiagrostis.*
Dichelachne.	*Orthoraphium.*
Macrochloa.	*Stipa.*
Eriocoma.	*Streptachne.*
Aristida.	*Stipagrostis.*

Tribe V. *Agrostideæ.*—Spikelets 1-flowered, very rarely with the awl-shaped rudiment of an upper flower. Glumes and paleæ 2, membranous-herbaceous; the upper palea usually artistate. Stigmas usually sessile. This tribe includes—

Mühlenbergia. *Lycurus.* *Phippsia.* *Cinna.* *Echinopogon.* *Agrostis.* *Nowodworskya.* *Chæturus.* *Pereilema.* *Clomena.* *Coleanthus.* *Colpodium.* *Epicampes.* *Sporobolus.* *Gastridium.* *Polypogon.* *Ægopogon.*

Stipa.

Apera.

Tribe VI. *Arundineæ.*—Spikelets either 1-flowered, with or without the rudiment of an upper floret, or many-flowered. Florets usually surrounded or covered with long soft hairs. Glumes and paleæ 2, membranous-herbaceous, the former usually as long as the florets or longer, of the latter the lower awned or awnless. Usually tall grasses. It includes—

Sericura. *Deyeuxia.* *Pentapogon.* *Arundo.* *Graphephorum.* *Amphidonax.* *Calamagrostis.* *Lachnagrostis.* *Ammophila.* *Ampelodesmos.* *Phragmites.* *Gynerium.*

Calamagrostis.

Tribe VII. *Pappophoreæ.*—Spikelets 2-many-flowered, the upper withering. Glumes and paleæ 2, membranous-herbaceous. Lower palea with 3 or more subulate awned divisions. Inflorescence capitate-spiked or panicled. It includes—

Amphipogon. *Trirhaphis.* *Enneapogon.* *Euraphis.* *Echinaria.* *Diplopogon.* *Pappophorum.* *Polyrhaphis.* *Cottæa.* *Cathestecum.*

Enneapogon.

Tribe VIII. *Chlorideæ.*—Spikelets in unilateral spikes, 1-many-flowered; the upper florets withering. Glumes and paleæ 2, membranous-herbaceous, the latter awnless or awned, the former permanent on the rachis, and the anterior one inserted higher up than the other. Spikes digitate or panicled, rarely solitary. Rachis continuous, not jointed. It includes—

Microchloa. *Cynodon.* *Eustachys.* *Leptochloa.* *Harpochloa.* *Melanocenchris.* *Opizia.* *Eutriana.* *Aristidium.* *Triplathera.* *Gymnopogon.* *Pentarhaphis.* *Triæna.* *Pleuraphis.* *Schœnefeldia.* *Dactyloctenium.* *Chloris.* *Eleusine.* *Ctenium.* *Chondrosium.* *Spartina.* *Atheropogon.* *Heterostega.* *Triathera.* *Polyodon.* *Polyschistis.* *Triplasis.* *Bromidium.*

Chloris.

Tribe IX. *Aveneæ.*—Spikelets 2-many-flowered; the terminal floret usually withering. Glumes and paleæ 2, membranous-herbaceous; the lower palea mostly awned; the awn usually dorsal and twisted. It includes—

Hierochloe. *Ataxia.* *Corynephorus.* *Dupontia.* *Airopsis.* *Lagurus.* *Colobanthus.* *Trichæta.* *Avena.* *Tristachya.* *Trichopterya.* *Brandtia.* *Chætobromus.* *Triodia.* *Anthoxanthum.* *Podopogon.* *Deschampsia.* *Aira.* *Trisetaria.* *Trisetum.* *Rostraria.* *Acrospelion.* *Arrhenatherum.* *Anisopogon.* *Eriachne.* *Danthonia.* *Uralepis.* *Pommereulla.*

Danthonia.

Tribe X. *Festuceæ.*—Spikelets many-flowered, rarely few-flowered. Glumes and paleæ 2, membranous-herbaceous, rarely coriaceous, the latter usually furnished with an awn which is not twisted. Inflorescence almost always panicled. It includes—

Bromidæ.

Sesleria. *Æluropus.* *Dissanthelium.* *Phalaridium.* *Glyceria.* *Lophochlæna.* *Eatonia.* *Cœlachne.* *Chascolytrum.* *Poa.* *Eragrostis.* *Tetrachne.* *Centotheca.* *Hydrochloa.* *Pleuropogon.* *Catabrosa.* *Briza.* *Calotheca.*

Anthochloa.	*Melica.*
Molinia.	*Airochloa.*
Kœleria.	*Schismus.*
Wangenheimia.	*Dactylis.*
Lasiochloa.	*Urochlœna.*
Cynosurus.	*Chrysurus.*
Lamarckia.	*Ectrosia.*
Lophatherum.	*Elytrophorus.*
Plagiœlytrum.	*Festuca.*
Amphibromus.	*Bromus.*
Orthoclada.	*Uniola.*
Diarrhena.	

Bambusidæ.

Arundinaria.	*Arthrostylidium.*
Phyllostachys.	*Streptogyna.*
Chusquea.	*Merostachys.*
Guadua.	*Nastus.*
Schizostachyum.	*Bambusa.*
Beesha.	*Streptochæta.*

Briza.

Tribe XI. *Hordeæ.*—Spikelets 3-many-flowered; sometimes 1-flowered. Terminal floret withering. Glumes (occasionally deficient) and paleæ 2, herbaceous. Stigma sessile. Ovary mostly hairy. Inflorescence spiked; spike simple, solitary; rachis sometimes winged. In this tribe are collected the *Cerealia*, namely, wheat, barley, rye, &c. It includes—

Lolium.	*Triticum.*
Secale.	*Elymus.*
Gymnostichum.	*Hordeum.*
Ægilops.	*Polyanther ix.*
Pariana.	

Hordeum.

Tribe XII. *Rottboëllcæ.*—Inflorescence spiked; the rachis in most cases jointed. Spikelets 1-2- or very rarely 3 flowered, lodged in hollows of the rachis; either solitary or in pairs, one being stalked and withering. One floret of each spikelet, either the upper or the lower, usually incomplete. Glumes 1-2, sometimes altogether wanting,

Rottboëlla.

mostly coriaceous. Paleæ membranous, awnless, or now and then awned. Style 1-2, sometimes very short, or altogether absent. It includes—

Nardus.	*Psilurus.*
Lepturus.	*Oropetium.*
Ophiurus.	*Hemarthria.*
Vossia.	*Mnesithea.*
Rottboëlla.	*Ratzeburgia.*
Xerochloa.	*Tripsacum.*
Manisuris.	

Tribe XIII. *Andropogoneæ.*—Spikelets 2-flowered; the lower floret being almost always incomplete. Palea thinner than the glumes, usually transparent. It includes—

Perotis.	*Leptothrium.*
Zoysia.	*Dimeria.*
Arthraxon.	*Eriochrysis.*
Saccharum.	*Imperata.*
Pogonatherum.	*Erianthus.*
Eulalia.	*Leptatherum.*
Apocopis.	*Elionurus.*
Anthistiria.	*Perobachne.*
Diectomis.	*Apluda.*
Batratherum.	*Hologamium.*
Lepeocercis.	*Anatherum.*
Trachypogon.	*Andropogon.*
Heteropogon.	*Ischæmum.*
Pogonopsis.	*Thelepogon.*
Arthropogon.	*Zeugites.*
Alloteropsis.	*Blyttia.*

Pogonatherum.

The following list of British genera is from Babington's 'Manua of British Botany:'—

Digitaria.	*Echinochloa.*
Setaria.	*Phalaris.*
Anthoxanthum.	*Hierochloe.*
Phleum.	*Alopecurus.*
Knappia.	*Gastridium.*
Polypogon.	*Milium.*
Agrostis.	*Apera.*
Stipa.	*Arundo.*
Psamma.	*Phragmites.*
Cynodon.	*Spartina.*
Leersia.	*Sesleria.*
Lagurus.	*Aira.*
Corynephorus	*Trisetum.*
Avena.	*Arrhenatherum.*
Holcus.	*Triodia.*
Kœleria.	*Melica.*
Molinia.	*Catabrosa.*
Poa.	*Glyceria.*
Sclerochloa.	*Briza.*
Cynosurus.	*Dactylis.*
Festuca.	*Bromus.*
Serrafalcus.	*Brachypodium.*
Triticum.	*Lolium.*
Elymus.	*Hordeum.*
Nardus.	*Lepturus.*

"The family is very numerous. Persoon's 'Synopsis' contains 812 species, 1-26th part of all the plants therein enumerated. In the system of Roemer and Schultes there are 1800, and since this work, were it brought to a conclusion, would probably contain 40,000 in all, it may be assumed that the grasses form a 22nd part. It is more than probable however that in future the grasses will increase in a larger ratio than the other phanerogamic plants, and that perhaps the just proportion will be as 1 to 20 or as 1 to 16. Greater still will be their proportion to vegetation in general when the number of individuals is taken into account, for in this respect the greater number, nay perhaps the whole, of the other classes are inferior. With regard to locality in such a large family, very little can be advanced.

"Among the grasses there are both land and water, but no marine plants. They occur in every soil, in society of others and alone, the last in such a degree as entirely to occupy considerable districts. Sand appears to be less favourable to this class, but even this has species nearly peculiar to itself. The diffusion of this family has almost no other limits than those of the whole vegetable kingdom. Grasses occur under the equator, and *Agrostis algida* was one of the few plants which Phipps met with on Spitzbergen. On the mountains of the south of Europe *Poa disticha* and other grasses ascend almost to the snow line, and on the Andes this is also the case with *P. malulensis* and *P. dactyloides*, *Deyeuxia rigida*, and *Festuca dasyantha*. The greatest differences between tropical and extra-tropical grasses appear to be the following:—

"1. The tropical grasses acquire a much greater height, and occasionally assume the appearance of trees. Some species of *Bambusa* are from 50 to 60 feet high.

"2. The leaves of the tropical grasses are broader and approach more in form to those of other families of plants. Of this the genus *Paspalus* affords many examples.

"3. Separate sexes are more frequent in the tropical grasses. *Zea*, *Sorghum*, *Andropogon*, *Olyra*, *Anthistiria*, *Ischæmum*, *Ægilops*, and many other genera which only occur in the torrid zone, and are there found in perfection, are monœcious or polygamous. *Holcus* is perhaps the only extra-tropical genus with separate sexes.

"4. The flowers are softer, more downy, and elegant.

"5. The extra-tropical grasses on the contrary far surpass the tropical in respect of the number of individuals.

"That compact grassy turf, which especially in the colder parts of the temperate zones in spring and summer composes the green meadows and pastures, is almost entirely wanting in the torrid zone. The grasses there do not grow crowded together, but like other plants, more dispersed. Even in the southern parts of Europe the assimilation to the warmer regions in this respect is by no means inconsiderable.

"*Arundo donax* by its height reminds us of the Bamboo, *Saccharum Ravennæ*, *S. Teneriffæ*, *Imperata arundinacea*, *Lagurus ovatus*, *Lygeum spartum*, and the species of *Andropogon*, *Ægilops*, &c., by separate sexes exhibit tropical qualities. The grasses are also less gregarious, and meadows seldomer occur in the south than in the north of Europe. The generality are social plants.

"The distribution of cultivated grasses is one of the most interesting of all subjects. It is determined not merely by climate but depends on the civilisation, industry, and traffic of the people, and often on historical events. Within the northern polar circle agriculture is found only in a few places. In Siberia grain reaches at the utmost only to 60°, in the eastern parts scarcely above 55°, and in Kamtschatka there is no agriculture even in the most southern parts (51°). The polar limit of agriculture on the north-west coast of America appears to be somewhat higher, for in the more southern Russian possessions (57° to 52°) barley and rye come to maturity. Only in Europe, namely in Lapland, does the polar limit reach an unusually high latitude. Beyond this dried fish, and here and there potatoes, supply the place of grain.

"The grains which extend farthest to the north in Europe are barley and oats. These, which in the milder climates are not used for bread, afford to the inhabitants of the northern parts of Norway and Sweden, of a part of Siberia and Scotland, their chief vegetable nourishment. Rye is the next which becomes associated with these. This is the prevailing grain in a great part of the northern temperate zone, namely in the south of Sweden and Norway, Denmark, and in all the lands bordering on the Baltic, the north of Germany, and part of Siberia. In the latter another very nutritious grain, buckwheat, is very frequently cultivated. In the zone where rye prevails wheat is generally to be found, barely being here chiefly cultivated for the manufacture of beer, and oats supplying food for the horses. To these there follows a zone in Europe and Western Asia where rye disappears, and wheat almost exclusively furnishes bread. The middle and the south of France, England, part of Scotland, a part of Germany, Hungary, the Crimea, and Caucasus, as also the lands of middle Asia, where agriculture is followed, belong to this zone. Here the vine is also found, wine supplants the use of beer, and barley is consequently less raised. Next comes a district where wheat still abounds, but no longer exclusively furnishes bread, rice and maize becoming frequent. To this zone belong Portugal, Spain, part of France on the Mediterranean, Italy and Greece, further, the countries of the East, Persia, Northern India, Arabia, Egypt, Nubia, Barbary, and the Canary Islands; in these latter countries however the culture of maize or rice towards the south is always more considerable, and in some of them several kinds of *Sorghum* (Doura) and *Poa Abyssinica* come to be added. In both these regions of wheat, rye only occurs at a considerable elevation, oats however more seldom, and at last entirely disappear, barley affording food for horses and mules. In the eastern parts of the temperate zone of the old continent, in China and Japan, our northern kinds of grain are very unfrequent, and rice is found to predominate. The cause of this difference between the east and the west of the old continent appears to be in the manners and peculiarities of the people. In North America, wheat and rye grow as in Europe, but more sparingly. Maize is more reared in the western than in the old continent, and rice predominates in the southern provinces of the United States. In the torrid zone, maize predominates in America, rice in Asia; and both these grains in nearly equal quantity in Africa.

"The cause of this distribution is, without doubt, historical, for Asia is the native country of rice, and America of maize. In some situations, especially in the neighbourhood of the tropics, wheat is also met with, but always subordinate to these other kinds of grain. Besides rice and maize there are in the torrid zone several kinds of grain as well as other plants which supply the inhabitants with food, either used along with them or entirely occupying their place. Such are, in the new continent, Yams (*Dioscorea alata*), the Manihot (*Jatropha Manihot*), and the Batatas (*Convolvulus Batatas*), the root of which and the fruit of the Pisang (*Banana Musa*) furnish universal articles of food; in the same zone in Africa, Doura (*Sorghum*), Pisang, Manihot, Yams, and *Arachis hypogæa*; in the East Indies and on the Indian Islands, *Eleusine coracana*, *E. stricta*, *Panicum frumentaceum*, several Palms, and *Cycadaceæ* which produce the Sago, Pisang, Yams, Batatas, and the Broad-Fruit (*Artocarpus incisa*). In the islands of the South Sea, grain of every kind disappears, its place being supplied by the bread-fruit tree, the pisang, and *Tacca pinnatifida*. In the tropical parts of Australia there is no agriculture, the inhabitants living on the produce of the sago, of various palms, and some species of *Arum*.

"In the high lands of South America, there is a distribution similar to that of the degrees of latitude. Maize indeed grows to the height of 7200 feet above the level of the sea, but only predominates between 3000 and 6000 feet of elevation. Below 3000 feet it is associated with the pisang and the above mentioned vegetables, while from 6000 to 9260 feet the European grains abound: wheat in the lower regions, rye and barley in the higher, along with which *Chenopodium Quinoa* as a nutritious plant must also be enumerated. Potatoes alone are cultivated from 9260 to 12,300 feet. To the south of the tropic of Capricorn, wherever agriculture is practised, considerable resemblance with the northern temperate zone may be observed. In the southern parts of Brazil, in Buenos Ayres, in Chili, at the Cape of Good Hope, and in the temperate zone of Australia, wheat predominates; barley however and rye make their appearance in the southernmost parts of these countries, and in Van Diemen's Land. In New Zealand the culture of wheat is said to have been tried with success, but the inhabitants avail themselves of the *Acrostichum furcatum* as the main article of sustenance. Hence it appears that in respect of the predominating kinds of grain, the earth may be divided into five grand divisions, or kingdoms — the kingdom of rice, of maize, of wheat, of rye, and lastly of barley and oats. The first three are the most extensive; the maize has the greatest range of temperature, but rice may be said to support the greatest number of the human race." Schouw, in Jameson's 'Philosophical Journal.'

The uses of this most important tribe of plants for fodder, food, and clothing, require little illustration. The abundance of wholesome fæcula contained in their seeds renders them peculiarly well adapted for the sustenance of man; and if the Cereal Grasses only, such as Wheat, Barley, Rye, Oats, Maize, Rice, and Guinea Corn, are the kinds commonly employed, it is because of the large size of their grain compared with that of other grasses; for none are unwholesome in their natural state with the exception of *Lolium temulentum*, a common weed in many parts of England, the effects of which are undoubtedly injurious. *Bromus purgans* and *catharticus* are said to be emetic and purgative; *Bromus mollis* is also unwholesome, and *Festuca quadridentata* is said to be poisonous; *Molinia varia* is injurious to cattle; and some other species are supposed to affect the milk of cows which graze upon them.

Among corn-plants not generally known may be mentioned *Eleusine caracana*, called Natchuco on the Coromandel coast, and Nagla Ragee, or Mand, elsewhere in India; *Setaria Germanica*, yielding German millet; and *Panicum frumentaceum*. There are many other species.

The value of grasses as fodder for cattle is hardly less than that of corn for human food. The best fodder-grasses of Europe are usually dwarf species, or at least such as do not rise above four or five feet from the ground. The most esteemed are *Lolium perenne*, *Phleum*, and *Festuca pratensis*; *Cynosurus cristatus*, and various species of *Poa* and dwarf *Festuca*. The fodder-grasses of Brazil are of far more gigantic stature, and perfectly tender and delicate. In Australia the favourite is *Anthistiria australis*, or Kangaroo Grass; in India *A. ciliata* is also in request; but the most common Indian fodder-grass is Doorba, Doorwa, or Hurryaleo (*Cynodon dactylon*). Gama Grass (*Tripsacum dactyloides*) has a great reputation as fodder in Mexico; and attention has lately been directed to the Tussac Grass of the Falklands (*Festuca flabellata*), a species forming tufts five or six feet high, and said to be unrivalled for its excellence as food for cattle and horses.

The fragrance of our sweet Vernal Grass is by no means confined to it; other species possess the same quality, which is connected with the presence of aromatic secretions, which have in part recommended grasses to the notice of medical practitioners. Sugar is a general product of grasses. It exists in great quantities in the Sugar-Cane (*Saccharum officinarum*). Maize so abounds in it, that its cultivation has been proposed in lieu of the sugar-cane.

For economical purposes Grasses are often of much importance. The strong stems of the bamboo are employed instead of timber and cordage. The cuticle of some species contains silex, which occurs in large masses after the burning of a heap of corn or a stack of hay in the shape of a colourless glass mass.

For an account of the diseases of this tribe of plants see ENTOPHYTA, ERGOT, and FUNGI. The uses of various species are described under ANATHERUM, COIX, DONAX, ELEUSINE, CYNODON, GYNERIUM, ARUNDO, and ELYMUS.

(Lindley, *Vegetable Kingdom*; Babington, *Manual of British Botany.*)

GRAMMATITE. [HORNBLENDE.]

GRAMMATOPHORA. [DRACONINA.]

GRAMPUS. [CETACEA.]

GRANADILLA. [PASSIFLORA.]

GRANATEÆ, a natural order of Plants separated by David Don from *Myrtaceæ* [MYRTACEÆ], and containing only the species of the genus *Punica*. [PUNICA.] It differs from *Myrtaceæ* in the leaves being destitute of glands, and in being without the intramarginal vein, as also in the nature of its fruit, its pulpy seeds, and convolute cotyledons. (G. Don, *Dichlamydeous Plants.*)

GRANATUM. [PUNICA.]

GRANITE, one of the most abundant rocks seen at or near the surface of the earth, and, from the variety of discussions to which it has given rise, one of the most celebrated. Wherever the stratified rocks, which were deposited by water, are seen to their very base, they are in all quarters of the world observed to rest on other unstratified rocks of the nature of granite. This rock appears in many instances to have been in a fluid state since the deposition of those strata which cover it, for it is seen to penetrate into their cracks and fissures, just as iron enters in veins the cracks of the sandstone which forms the sides or bed of the furnace. The fluidity of granitic rocks is now almost universally attributed, and with sufficient reason, to the effect of great heat analogous in its origin to that which supplies the energies of volcanoes, but probably more general in its distribution and more uniform in its action.

It is impossible to say how much of the mass of the earth is composed of granitic rocks, though from the matter thrown up by volcanoes we see that mineral compounds in some degree analogous exist to considerable depths. To what extent it can be demonstrated that the sedimentary stratified rocks have been derived from disintegrated granites is yet uncertain, and Sir Charles Lyell has recently introduced the consideration of the more difficult question, whether granite has not been produced and may not still be forming by the remelting of such sedimentary aggregates into the general mass of the interior of the globe. The bare mention of such expanded views shows the high interest which attaches to the contemplation of granite. [GEOLOGY.]

Granite is one of the most beautiful of rocks, and viewed mineralogically its composition is remarkable. Mica, felspar, and quartz, in distinct crystals, or else filling interstices between crystals, constitute the typical varieties, and the most abundant masses of granite; but it is impossible so to limit the signification of the term. Hornblende must be included among the legitimate constituents of granite, if we are to use the term in a manner at all consistent with geological experience or the variations of granitic compounds. Other minerals, especially actinolite, chlorite, talc, compact felspar, steatite, garnet, zircon, &c., enter into and sometimes considerably modify the aspect of granite. The colours vary: the felspar is red, gray, yellow, white, green; the quartz is usually clear white or gray; the mica is black, gray, white, brown, and in various degrees silvery; the hornblende is dark green or black. The mica and felspar are invariably, and often (especially in cavities) beautifully crystallised; the quartz commonly fills the interstitial spaces left by these minerals, but small pyramidal crystals of quartz in great perfection may be sometimes seen imbedded in the faces of the prismatic felspar crystals, which are also sometimes penetrated by the filmy plates of mica.

Except in the veins which ramify into stratified rocks, and there grow fine-grained and even compact (like the base of some porphyries), granite, as its name implies, shows the grains of its component parts: the size of these varies extremely. The mica in the granite of Rubieslaw, near Aberdeen, forms laminæ some inches across; but in that of Cornwall, Skiddaw, &c., it exists in small plates; the felspar in graphic granite is almost one huge crystallised mass; large detached crystals in the granites of Shap and Ben Nevis make those rocks porphyritic, but in some of the building granites of Aberdeen all the ingredients are in small grains.

The proportion of the ingredients in typical granite varies greatly: the mica is sometimes absent, or replaced by hornblende. The following is a general view of the most remarkable granitic mixtures, to which some authors apply distinctive names, but we think with little advantage to geology. Some of these, mineralogically speaking, are identical with rocks of the trap family [SYENITE], but certainly occur as parts of a granitic series, viewed geologically. (M'Culloch, 'On Rocks.')

Binary Granite, composed of two ingredients: — as felspar and mica, quartz and felspar, either equally blended (as in Muncaster Fell, Cumberland), or in segregated portions (as the graphic granite); quartz and hornblende (M'Culloch); felspar and hornblende.

Granite of three ingredients (the typical varieties):—
- Quartz, felspar, and mica, uniformly blended, or with distinct additional crystals of felspar, then called Porphyritic Granite.
- Quartz, felspar, and hornblende. (Syenite of authors.)
- Quartz, felspar, and mica. (Instead of the mica, chlorite or talc sometimes appears.)

Granite of four ingredients:—
- Quartz, felspar, mica, and hornblende, or actinolite. (Syenite of some authors.)
- Quartz, felspar, mica, and compact felspar, or porcelain clay.
- Quartz, felspar, hornblende, and chlorite, or steatite.

GRAPE-HYACINTH. [MUSCARI.]

GRAPE-VINE. [VITIS.]

GRAPHIDACEÆ. [LICHENS.]

GRAPHIS. [LICHENS.]

GRAPHITE, *Plumbago, Black Lead.* This substance occurs crystallised and massive. Primary form a rhomboid. Occurs in imbedded hexagonal prisms. Cleavage parallel to the terminal planes of the prism, very distinct, and the laminæ flexible. Fracture granular and uneven. Hardness 1·0 to 2·0. Colour steel or blackish-gray. Streak black, shining. Lustre metallic and glistening. Unctuous to the touch. Opaque. Specific gravity 2·08 to 2·45.

Found in Greenland and in the neighbourhood of Philadelphia in the United States.

The massive varieties occur amorphous, in reniform masses and irregular nodules. Structure foliated, granular, compact.

Found in various parts of the world. That of Borrowdale in Cumberland is of the best quality for what are called black-lead pencils; while the commoner sorts are used for making melting-pots, for diminishing the friction of machinery, and for protecting iron from rusting. That which is imported from the East Indies is remarkably soft. Plumbago conducts electricity, is infusible, and very difficult of combustion.

Professor Vanuxem has analysed several varieties of Graphite. No. 1 was a pure specimen from Borrowdale, and No. 2 from Bustletown, Pennsylvania.

	No. 1.	No. 2.
Carbon	88·37	94·4
Silica	5·10	2·6
Alumina	1·00	—
Water	1·23	0·6
Oxides of Iron and Manganese	3·60	1·4
	99·30	99·0

It was at one time supposed that Graphite was a carburet of iron, but, in the opinion of Berzelius, the experiments of Karsten have proved that it is a peculiar form of carbon, and that the substances which it contains are in a state of mixture merely and not of chemical combination.

According to Dr. Thomson, Graphite is found usually in primary or transition rocks. At Borrowdale it occurs in nests in a greenstone rock, which constitutes a bed in clay-slate. In Inverness-shire it occurs in gneiss; at Arendal in Norway, in quartz-rock; and in the United States, in felspar and mica-slate, but always in primary rocks.

The material for lead-pencils, when of the finest quality, is first calcined and then sawn up into strips of the requisite size, and commonly set in wood (usually cedar) as they appear in the market. It is much used now in small cylinders, without wood, for ever-pointed pencil-cases. Graphite that cannot be thus used for pencils is reduced to a powder, and on being submitted to pressure it is made to adhere into a solid mass, which is subsequently cut up in the way referred to above. Graphite is also added to clay for making a kind of pottery. It is also extensively employed for diminishing the friction of machinery, also for the manufacture of crucibles and furnaces, which withstand a great heat. For this purpose it is mixed with half its weight of clay. It is also employed as a wash for giving a gloss to iron-stoves and railings.

GRAPSIDÆ, *Grapsoidians*, a tribe of Brachyurous Crustaceans belonging to the family of *Catametopes*, placed by M. Milne-Edwards between the Gonoplacians and the family of the Oxystomes, and approaching in his opinion nearer to the tribe of Gonoplacians than to the Ocypodians. He gives the following as the characters of the Grapsoidians:—

Carapace in general less regularly quadrilateral than in the Gonoplacians and Ocypodians: its lateral borders are nearly always slightly curved, and its fronto-orbital border frequently does not occupy more than about two-thirds of its transversal diameter. The body is nearly always compressed, and the sternal plastron but little or not at all curved from before backwards. The front is nearly always strongly recurved, or rather bent down, and very wide, occupying about the half of the anterior border of the carapace, and exceeding on each side the edge of the lateral borders of the buccal frame. The orbits are oval-shaped and of moderate size; and the lateral borders of the carapace are slightly curved and nearly always trenchant. The ocular pedicles are large and short; their insertion is below the front, and the cornea occupies one-half of their length. The internal antennæ are sometimes vertical and lodged in distinct pits (fossettes), which are open at the upper surface of the carapace; but in the great majority of instances these organs are entirely transversal and completely covered above by the front; their terminal stem is nearly always of the ordinary length, and terminated by elongated and multiarticulate appendages which are very distinct. The external antennæ here fill the gap which exists between the front and the inferior orbital border, and which forms a communication for the antennary pits with the orbits. Their first joint is nearly always short, but rather large, and nearly entirely covered by the front. The three following joints and the terminal stem are very little developed. The anterior border of the epistome is always placed on the same line as the inferior border of the orbit, with which it is continuous. The buccal frame is but little or not at all narrowed in front, and the terminal stemlet of the external jaw-feet always springs from the middle of the anterior border, or from the external angle of the preceding joint, and is never hidden below it. The palp of these jaw-feet presents nearly the same form as in the crabs; it is large, and terminated by a multiarticulate appendage bent back inwards under the third joint of those members. The sternal plastron is not very wide backwards, and gives insertion to the intromissive organs. The disposition of the feet varies; those of the first pair are in general short, and those of the four last pairs are very much compressed; these last are sometimes natatory, a character which is not met with in any other crustacean of this family. The abdomen is composed of seven joints, and its second articulation extends nearly always, in both one and the other sex, as far as the origin of the posterior feet. The thoracic branchiæ generally amount to seven on each side. The epimere of the last thoracic ring is nearly as much developed as that of the preceding ring, and concurs to form the vault of the flanks; thus the superior or epimerean cellule of this penultimate ring does not cover the cellule which corresponds to the posterior foot, as is the case in the Gecarcinians.

The greater numbers of the tribe, as far as the manners of the crustaceans composing it are known, live on the shore, or on the rocks which border the coasts; they are very timorous, and run away with much swiftness.

M. Milne-Edwards, who gives the above definition and account of the Grapsoidians, divides the tribe into seven genera, namely:—

Sesarma (Say).—Carapace quadrilateral, nearly equilateral generally, and very much elevated in front; fronto-orbital border occupying its whole width; lateral borders straight, and posterior border very long. Front nearly always suddenly bent down, and its length very considerable, exceeding half of the transversal diameter of the carapace. Eyes large and of moderate length; orbits inclining to oval, with generally at their external angle a large gap, which is continued with a horizontal gutter situated immediately below the lateral border of the carapace, a character found in *Macrophthalmus*, but which does not exist in the majority of the Grapsoidians; lower border of the orbit horizontal and directed forwards; a very strong tooth is directed towards the front from its internal part. Antennary pits transversely oval, and the space which separates them generally very large. Basilary joint of the external antennæ more or less cordiform, giving insertion to the succeeding joint in a notch situated in the middle of its internal border; its width is considerable, although the front exceeds it laterally. Epistome very short and projecting, like all the surrounding parts; it is continued with the inferior orbitary border, and below that border there is a horizontal gutter which terminates at the angle of the buccal frame; there are also other furrows under the pterygostomian regions, the surface of which is granulous or reticulated; it is generally divided into small squares of great regularity, and this character alone would suffice to distinguish the greater part of the species of *Sesarma* from nearly all the other *Catametopes*. The disposition of the external jaw-feet is also very remarkable; for there is always a wide lozenge-shaped space between them, and their third joint longer than it is wide, and longer than the second, is rather oval, and but little or not at all truncated anteriorly. It is also to be noted that there exists on the surface of this lamellar portion of the external jaw-feet a projecting line or crest which is carried obliquely from its external and posterior angle to its interior (anterior?) and internal angle; this crest is generally furnished with hair, and there is a deep furrow near its external border. The sternal plastron is generally convex from behind forwards, and in the male the anterior portion of the cavity which receives the abdomen is rounded and surrounded with a small border. The anterior feet of the male are nearly always much longer than those of the second pair, and terminated by a strong and convex hand. Sometimes it is the same with the female. The feet of the second pair are shorter than those of the third, and terminate, like all the succeeding feet, by a large rounded styliform joint which is more or less distinctly canaliculated, generally downy, and almost always completely devoid of spines. The second ring of the abdomen is in general nearly linear, and the last is much more narrow at its base than the penultimate ring, so that at this point the abdomen is abruptly narrowed. In the female the last joint of the abdomen is very small, and in general lodged almost entirely in a notch of the preceding ring.

The species of this genus are found upon the coasts of America, Africa, and Asia.

Mr. Say, who first separated these crustaceans under the generic name *Sesarma*, afterwards reunited them to *Grapsus*; but M. Milne-Edwards, who has entered into the details of the construction of *Sesarma* above given, in order to point out its distinctions, is of opinion that it ought to be distinguished, and to be considered as constituting the type of a rather numerous genus, which the latter divides into the following sections:—

A. Species whose carapace is at least as wide as it is long, and but little or not at all narrowed posteriorly.

a. Lateral borders of the carapace armed with two or three teeth (comprising the external orbital angle). Body very thick, especially before.

S. tetragona (*Cancer tetragonus* (?), Fabr.; *C. fascicularis*, Herbst; *Ocypode tetragona*, Olivier; *Grapsus tetragona*, Latreille). Length 28 lines. Locality, Indian Ocean.

a a. Lateral borders presenting no tooth behind the angle of the external orbit. Body depressed.

S. quadrata (*Cancer quadratus*, Fabr.; *Ocypode plicata*, Bosc.) Length, 8 lines. Locality, the neighbourhood of Pondicherry.

B. Species whose carapace is much longer than it is wide, and strongly narrowed backwards.

S. Pisonii (*Arata pinima* of Piso). Length, 8 lines. Locality, the Antilles. M. Milne-Edwards says that Latreille has confounded this species with *Grapsus cruentatus*. M. Milne-Edwards is also of opinion that *G. Husardii* (Desmarest) and *Cancer Hispanus* (Herbst) belong to this genus.

Cyclograpsus (Milne-Edwards).—Body much less flattened than in *Grapsus* and wider, the transversal diameter of the carapace much exceeding its length. Front inclined, but far from being vertical. Lateral borders of the shell elevated, delicate, and very much curved, and its lateral walls forming ordinarily a nearly straight angle with its upper surface. Eyes nothing remarkable; orbits directed forwards and presenting almost always below their external angle a wide and deep notch, which, as in *Sesarma*, is continued backwards with a transversal gutter hollowed out in the pterygostomian regions of the carapace below its lateral border. Antennary pits much less narrow than in *Grapsus*, and the basilary joint of the externa antennæ much less wide. External jaw-feet much resembling those of *Grapsus*: their third joint shorter than the second, wide as it is long, enlarged anteriorly and strongly truncated at its anterior border; a small projecting and piliferous crest runs obliquely from the anterior and interior angle of this joint to the posterior and external angle of the preceding joint, so as to form with that of the opposite side a triangle, the base of which is backwards; the external appendage of these jaw-feet nearly reaches the anterior border of the third joint of their stem, and terminates by a multiarticulate appendage. Feet of nearly the same form and disposition as in *Grapsus*, except that the tarsus is not so large, and has no spines.

The species are distributed in the seas of Asia exclusively. (Milne-Edwards.)

M. Milne-Edwards divides the genus into the following sections:—

A. Species having the lateral border of the carapace entire.

a. A deep gutter springing from the external orbital gap and directed forwards.

C. punctatus. Length, 15 lines. Locality the Indian Ocean.

a a. No well-marked post-orbital gutter.

C. integer (*Grapsus integer*, Latreille). Length, 4 lines. Locality Brazil.

B. Species the lateral border of whose carapace is dentated.

b. External orbital gap but little marked. Orbits directed forward.

C. quadridentatus. Length, 10 lines. Locality, Australia.

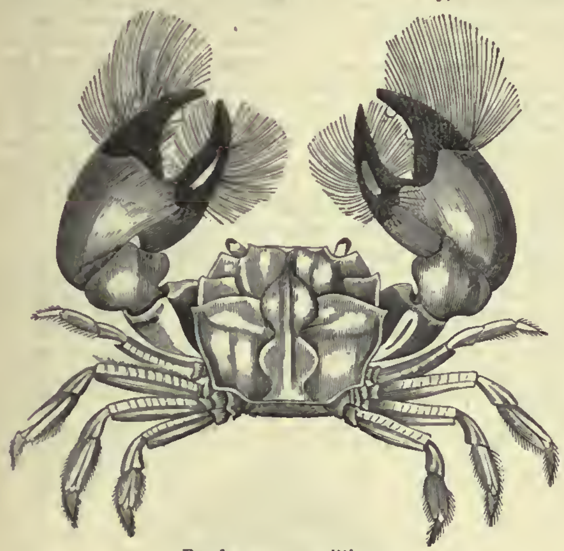
b b. External orbital gap very wide. Orbits very oblique.

C. Latreillii (*Grapsus venosus*, Latreille). Length, 4 lines. Locality, Mauritius.

Pseudograpsus (Milne-Edwards).—M. Milne-Edwards observes that one of the characters pointed out with reason by M. Latreille as distinguishing the natural groups of *Grapsus* and *Plagusia* is the having the external jaw-feet narrow and notched on their internal border, so that these organs, instead of closing the mouth completely, leave between them a vacant lozenge-shaped space; but he remarks that this disposition is not met with in all the species which are usually arranged under the genus *Grapsus*; and as these modifications of the buccal apparatus coincide with other characters, and seem to indicate a natural division among these animals, he has taken it as the basis of their classification, and proposes for those walking Grapsoidians whose mouth is completely closed by the external jaw-feet the name of *Pseudograpsus*, with the following generic character:—

General form approaching that of *Cyclograpsus* more than that of the other Grapsoidians, the body being thick, and the carapace, convex above, being rather regularly rounded on the sides. Basilary joint of the external antennæ nearly square and joined to the front, its external border being in contact with a vertical tooth which elevates itself on the floor (plancher) of the orbit, as in *Macrophthalmus* and the Ocypodians. Internal border of the second and third joint of the external jaw-feet straight, and this last joint, remarkable for being much wider than it is long, presents in the middle of its anterior border a notch whence springs the terminal stemlet (tigelle). Sternal plastron nearly circular, and slightly curved from before backwards. Anterior feet of the male very large, and much longer than any of the succeeding feet, which are rounded and terminated by a hairy tarsus, and completely deprived of spines. Abdomen of the male extending quite to the base of the posterior feet, and its second joint linear. The species are found in the Asiatic seas.

P. penciliger (*Cancer setosus* (?), Fabricius; *Grapsus pencilliger*, Latreille). The feet are rounded and furnished with a thick-set down. Length, rather more than an inch. Locality, seas of Asia.



Pseudograpsus pencilliger.

Grapsus (Lamarck, in part).—M. Milne-Edwards retains in this genus those species which are, for the most part, remarkable for the extreme flatness of the body, and present the following characters :—

Upper surface of the carapace always nearly horizontal and nearly square; its anterior border rarely occupies its whole width, but the difference is not considerable, and in general its posterior part is not narrowed—the lateral borders are delicate, and ordinarily a little curved. Stomachal region very large, and branchial regions very extended, and nearly always marked with salient oblique lines. Front very wide, and inclined or even completely bent down; the upper part, in general, divided into four lobes, which often become very projecting. Orbits deep, and their inferior border at least as salient as the superior border, but the external extremity does not open into a horizontal gutter situated under the lateral border of the carapace, as in *Sesarma*, and presents one or two small notches at most; the tooth which elevates itself from their lower wall, beneath the articulation of the eye, is in general very strong. Disposition of the antennæ nearly the same as in the preceding genus, except that the antennary pits are in general less wide, and separated by a narrow space between them. External jaw-feet strongly notched within, so as to leave between them a large vacant lozenge-shaped space; their third joint is trapezoidal, and terminates anteriorly by a straight and very wide border; it is in general nearly of the length of the second joint, and carries the succeeding joint at its external angle, but it is sometimes very short, strongly dilated on the external side, and gives insertion to the fourth joint towards the middle of its anterior border. Pterygostomian regions smooth, or very slightly granulous, and never presenting the disposition so remarkable in *Sesarma*. Feet of the first pair short, the arm enlarged and spiny within, hands short but rather stout in the males. The succeeding feet remarkably flattened; their third joint entirely lamellar below in its external moiety, its superior border delicate and elevated, and the tarsus large and very spiny. Second pair of feet much shorter than the third, which, in their turn, are in general much shorter than the penultimate feet. Abdomen of the male triangular; that of the female very wide, its last joint large, and not inclosed in a notch of the preceding joint, as in *Sesarma*.

Grapsus, as above modified, is spread over nearly all parts of the world. The known species generally inhabit rocky coasts, and run with great rapidity.

A. Species having the third joint of the external jaw-feet longer than it is wide, and without any remarkable dilatation towards the external angle.

G. pictus (*Pagurus maculatus*, Catesby; Cangrejo de Arrecife, Parra; *Cancer tenuicristatus*, Herbst; *Cancer grapsus*, Fabricius; *Grapsus pictus*, Latreille). Length, rather more than 2 inches. Colour red, with irregular yellow stains. Locality, the Antilles.

Catesby gives the following account of the habits of this species under the name of *Pagurus maculatus*, the Red-Mottled Crab :—"These crabs inhabit the rocks hanging over the sea; they are the nimblest of all other crabs; they run with surprising agility along the upright side of a rock, and even under rocks that hang horizontally over the sea; this they are often necessitated to do for escaping the assaults of rapacious birds which pursue them. These crabs, so far as I could observe, never go to land, but frequent mostly those parts of the promontories and islands of rocks in and near the sea, where, by the continual and violent agitation of the waves against the rocks, they are always wet, continually receiving the spray of the sea, which often washes them into it; but they instantly return to the rock again, not being able to live under water, and yet requiring more of that element than any of the crustaceous kinds that are not fish."

M. Milne-Edwards remarks that Messrs. Quoy and Gaimard brought from the Sandwich Islands a *Grapsus* which bears a strong analogy to *Grapsus pictus*, but which, it appears to him, ought to be distinguished from it, on account of the great number of little conical hairs disposed in small transversal ranks on the branchial and stomachal regions, the greater extent of the front, and some other characters; but as he had not examined more than one individual in a bad state of preservation, and as *Grapsus pictus* presents considerable individual differences, he cannot pronounce on the distinction decidedly, but notes the fact on account of its interest in regard of zoological geography. He observes that in the collection of the Paris Museum he has designated this crustacean under the name of *Grapsus rudis*, and that it is probably the species figured by Messrs. Quoy and Gaimard under the name of the Painted Grapsus. ('Voyage de M. Freycinet,' pl. 76, fig. 2.)

B. Third joint of the external jaw-feet as wide as it is long, and dilated outwards towards the anterior angle.

G. varius (Cancre Madrè (?), Rondelet; *Cancer marmoratus*, Fabricius; *Grapsus varius*, Latreille). Length about 18 lines. Colour violaceous-red, variegated with small irregular yellowish stains. Locality, the rocky parts of the coasts of Bretagne, Italy, &c. (very common).

Nautilograpsus (M. Edwards).—Differing but little from *Grapsus*. Carapace, instead of being wider than it is long and nearly flat, as in *Grapsus*, longer than it is large, and convex above. Regions not distinct. Front advanced, lamellar, and simply inclined. Lateral borders curved and long. Internal border of the second joint of the jaw-feet nearly straight, and the third joint even longer than in *Grapsus varius*, but nearly of the same form. Feet much shorter than in *Grapsus*. The intromissive organs of the male traverse a simple notch of the border of the sternal plastron. For the rest resembling the *Grapsi* of the second division.

The single species known is found in all latitudes and met with far at sea, often floating on *Fucus natans*, or on large marine animals.

N. minutus (*Cancellus marinus quadratus*, Sloane; Turtle-Crab, Browne; *Cancer minutus*, Fabricius; *Grapsus minutus*, Latreille; *Grapsus cinereus*, Say; Grapse Unie, Lamarck—Gal. du Mus.). Length from 4 to 8 lines, varying much in colour. M. Milne-Edwards says that he sees no sufficient reason for distinguishing this species from *Grapsus testudinum*, Roux.

Grapsus pictus.

Plagusia (Latreille). — Resembling *Grapsus* generally, but distinguished at once by a singular disposition of the internal antennæ not met with in any other brachyurous decapod, according to M. Milne-Edwards. These organs, instead of being bent back under the front, are each lodged in a deep notch in this part, so as always to be uncovered superiorly. Carapace broad and flattened, its anterior border occupying only one-half of its width, which is most extended towards the level of the last pair of feet but one. Portion of the front between the antennary pits triangular and curved downwards. Eyes short and large; orbits directed forwards and upwards, and separated from the antennary pits. Internal antennæ vertical; external antennæ occupying the internal angle of the orbit, and nearly of the same form as in *Grapsus*. Anterior border of the buccal frame very projecting, and continuous with the lower orbital border. The external jaw-feet close the mouth completely, and are not notched within as in *Grapsus;* they are in form generally very nearly the same as in the Crabs and *Portunus;* the third joint is much shorter than the preceding one, nearly square, and notched at its anterior and internal angle for the insertion of the succeeding joint. Sternum very wide and deeply notched backwards for the reception of the abdomen. Anterior feet generally moderate in the male and small in the female; claws ordinarily with a spoon-shaped termination; succeeding feet disposed as in *Grapsus;* sometimes the third, sometimes the fourth pair longest; they are in general ciliated on the superior border, and the tarsus is always armed with strong spines. Abdomen and branchiæ as in *Grapsus*.

Plagusia belongs more particularly to the Indian Ocean, and is found from the Cape of Good Hope to Chili. (M. Edwards.)

A. Species having the superior border of the last eight feet armed with teeth nearly throughout its length.

P. clavimana (*Cancer planissimus*, Herbst). Length rather more than an inch: antepenultimate ring of the abdomen soldered to the preceding ring in both sexes. It is found in Australia, and Vanicoro, New Zealand.

Plagusia clavimana.

B. Species whose last four pair of feet are not armed above with more than a single tooth placed near the extremity of the upper border of their third joint.

P. depressa (*Cancer depressus*, Herbst; *Grapsus depressus*, Latreille; *P. immaculata*, Lamarck; *P. depressa*, Latreille). It is a native of the Indian Ocean, seas of China, New Guinea, &c.

M. Milne-Edwards observes that the specific name of this *Plagusia* is badly chosen, inasmuch as it is less flattened than the greater part of the species. He is also of opinion that *P. depressa* of Say ('Acad. Philad.,' tom. i. p. 100) appears to be nearer to *P. squamosa* than the species here mentioned, but he thinks that it ought probably to be distinguished from it.

Varuna (M. Edwards).—Carapace very much depressed and nearly quadrilateral, but the lateral borders arched. Front wide, straight, and trenchant. Orbits approaching to oval; a fissure on their superior border, their external angle very salient, and hardly any inferior border. Internal antennæ bent back a little obliquely outwards, and their pits completely separated from the orbits by the basilary joint of the external antennæ, which joins the front, and presents nothing remarkable. Epistome larger than it is in the greater part of the Grapsoidians, and external jaw-feet nearly joining it; their internal border is nearly straight, and the third joint, very much dilated externally, carries the following joint towards the middle of its anterior border, which is very large and notched. Anterior feet large; and the succeeding feet, instead of terminating by a large and cylindrical or styliform tarsus, as in the other Grapsoidians, with their last joint wide, flattened, ciliated on the edges, and lanceolate. Abdomen of the male with seven distinct joints.

V. litterata (*Cancer litteratus*, Fabricius; *Grapsus litteratus*, Bosc.). Locality, Indian Ocean.

GRAPSUS. [GRAPSIDÆ.]

GRAPTO'LEPIS, a genus of Fossil Ganoid Fishes, from the Carboniferous system of Carluke. (Agassiz.)

GRAPTO'LITHUS (literally 'written-stone'), a name used by Linnæus chiefly to include appearances in stones resembling drawings—as of maps, ruins, vegetable forms, &c. Thus the Florentine, or Ruin Marble, the dendritical ramifications on many limestones, and the moss-like forms in agates, &c. were ranked as Graptolites.

Among the species included by Linnæus is one resembling *Algæ*, from the Transition Strata of Gothland.

GRASSHOPPER. [GRYLLIDÆ.]

GRASSHOPPER-WARBLER. [SALICARIA.]

GRASS-MOTHS. [CRAMBUS.]

GRATELU'PIA, a genus of Conchiferous *Mollusca*, established by M. Charles Desmoulins, for a fossil bivalve which had been confounded by M. de Basterot with the genus *Donax*, under the name of *Donax irregularis*. But one species, *Gratelupia donaciformis*, was known (from Bordeaux, Miocene Formation of Lyell), till Mr. Lea discovered a second in the Claiborne Tertiary (Eocene of Lyell), which he has named *Gratelupia Moulinsii*, after the founder of the genus. Diameter 1 inch, length 1·4, breadth 1·9. It has the following characters:—Animal unknown. Shell subtrigonal, equivalve, regular, nearly equilateral, a little attenuated at its posterior part, and presenting at the postero-inferior border a slight sinuosity. Umbones very small, projecting but little, and hardly inclined forwards. Hinge consisting of three cardinal divergent teeth in each valve, and of from three to six cardini-serial teeth converging towards their summits, lamellar, with their edges finely dentilated, and situated a little behind the summit, under the ligament; a single lateral anterior tooth under the lunule in the left valve, corresponding with a pit similarly situated in the right valve; external ligament long, convex, overpassing the serial teeth. Muscular impressions nearly equal, oval, united by a pallial impression largely and very deeply excavated backwards.

The genus was named by M. C. Desmoulins after Dr. Grateloup.

Gratelupia Moulinsii. (Lea.)

GRAUWACKE (or Graywacke, as it is often written in English works on geology), a German term applied to some of the ancient stratified rocks, which has been with some unwillingness admitted by English geologists, either in the original sense, signifying a particular kind of rock, or as typifying a group or series of strata in which such rocks form a conspicuous portion.

In the former sense Grauwacke Rocks may be considered as having almost the same relation to clay-slates that argillaceous sandstones and conglomerates bear to common clays; for argillaceous slate, by including rolled fragments or minute grains of quartz-sand, with or without mica, becomes the grauwacke and grauwacke slate of Werner and his followers. When the sand or gravel predominates so as nearly to exclude the argillaceous cement, the distinction between grauwacke and sandstone is almost imaginary, just as, on the other hand, indurated shale and soft clay-slate are not always certainly distinguishable. In the pass of Lennie, above Callender, in the Lammermuir Hills, in the primary series of rocks near Cavan in Ireland, and in Snowdon, the student may study examples of the genuine grauwacke of the German writers; while fine-grained sandy rocks, corresponding to the title of grauwacke slate, are common in Westmoreland, Cumberland, Wales, the Isle of Man, the Lammermuir Hills, &c.

Viewed geologically, the Grauwacke Rocks lie in the midst of the primary argillaceous strata, and constitute a part of the 'transition series' of the continental geologists. The 'grauwacke group' of Sir Henry De la Beche includes the Silurian Rocks of Sir Roderick Murchison, and a portion of the older strata designated as Cambrian Rocks by Professor Sedgwick. [GEOLOGY.] It is uncertain whether the term 'grauwacke' will in future be used merely to characterise rocks of a certain kind lying in the Cambrian or other series of argillaceous schists, or be allowed collectively to represent a geological group of strata.

Mr. Conybeare ('Reports of the British Association') is desirous of substituting for this somewhat rude term the more learned name of clasmoschist (κλάσμα, a fragment). M. Brongniart includes many varieties of grauwacke and grauwacke slate under the term psammite (ψάμμος, sand). [GEOLOGY; ROCKS; STRATIFICATION.]

GRAVEL. The small fragments of rocks which have been drifted by any forces of water over the surface of the earth are usually designated by this general term, which is happily free from any hypothetical meaning. Many parts of the surface of the earth are so covered. From the geographical phenomena, mode of accumulation, and other circumstances, the mode of action of the water may be often completely determined. It is certain that much of the undulated surface of the land has been traversed by powerful currents of water in directions different from those of the fresh-water streams now running; that in other cases the sea has acted on the land at greater heights and under different circumstances from what we now behold; and as a great part of the evidence for this is to be collected from the study of gravel deposits, we see how important is a right knowledge of the facts concerning these in repressing vain speculation and directing sound inferences. Whether the gravel observed at any spot was transported along the natural drainage hollows of the surface may be often certainly known by inspection of the nature of the fragments and the examination of the physical geography of the country in which they occur. Whether the waters descending these valleys performed the effects while flowing at higher levels, under the influence of dams, lakes, or other peculiarities, may also often be determined by suitable examination.

It will often be thus found that the gravel was not transported down the existing drainage hollows, but across hills and valleys, lakes, and arms of the sea. Under existing circumstances no ordinary action of nature can occasion such effects; it is therefore a question of great importance whether in ancient times the circumstances of physical geography were so different as to allow of the effects being performed by ordinary action, or whether an extraordinary action must be appealed to. The latter opinion has been held by diluvialists, reasoning on the distribution of gravel and large boulders of rock dispersed from the Alps and the Cumbrian Mountains; but various attempts have been made to explain the phenomena by supposed changes of physical geography, the aid of icebergs, &c. For determining this and such questions it should be examined—whether the gravel, &c., contains remains of organic beings; whether these are of land quadrupeds, land shells, land plants, or marine shells, bones of whales, dolphins, &c., in order to know whether the currents of water were derived from surface drainage or the movement of the sea. It is important to find out whether the gravel was deposited in still or agitated, in deep or shallow water, in lakes, flood-channels, or the sea: whether it now rests in included hollows, or in insular hills;—whether marine deposits of gravel alternate with others attributed to fresh-water currents;—whether gravel of local origin lies over or under other gravel brought from a distance.

GRAYHOUND, a variety of Dog remarkable for the keenness of its sight, the symmetrical strength and beauty of its form, and its great swiftness in the chase. There are many varieties of the Grayhound, from the Irish Grayhound and Highland breed (the latter made familiar to us by the pen of Sir Walter Scott and the pencil of Edwin Landseer), to the smoothed-haired southern breed, and that pretty pet, the Italian Grayhound.

In ancient times the Grayhound was one of the three animals whose presence marked the possessor to be a nobleman or gentleman; and we find it recorded as being accepted by kings in payment, as in the case of the fine paid to King John, consisting of "500 marks, 10 horses, and ten leashes of Grayhounds."

Formerly this hound was principally employed in chasing the stag. Thus Queen Elizabeth was gratified one day, after dinner, by seeing from a turret sixteen deer pulled down by Grayhounds upon the lawn at Cowdrey Park in Sussex; and the old ballads, 'Chevy Chase' among others, speak of their being used for the same sport in earlier times.

The well-known old lines descriptive of the perfections of a Grayhound have never yet been superseded:—

"Headed lyke a snake,
Neckyed lyke a drake
Fotted lyke a catte,
Taylled lyke a ratte;
Syded lyke a breme,
And chyned lyke a beme."

In modern times, many distinguished sportsmen (the earl of Orford in particular, who is said to have died on the field where his favourite bitch Old Czarina won a great match) have paid much attention to the breed, and have been rewarded by some of the best dogs ever seen. Major Osbaldeston, Major Topham, and Colonel Thornton were among those who were celebrated for the pure blood and admirable powers of their Grayhounds. The names of Czarina, Jupiter, Claret, Snowball, the Miller, Schoolboy, and Major, together with many others of note, are still familiar to those who attend the great coursing meetings. We refer the reader who is interested to 'The Sportsman's Cabinet,' 'Rural Sports,' 'The Courser's Manual,' 'The Sporting Magazine,' and similar works, for further information.

The Grayhound is supposed to have reached his full growth when two years old, and to be on the decline from his fifth or sixth year, when he is apt to begin to 'run cunning.' Dame Juliana Berners gives a greater latitude, making nine years the point at which he becomes too old for service:—

"And when he comes to that yere,
Have him to the tannere,
For the best whelp ever bitch had,
At nine years is full bad."

Sir Walter Scott, who quotes these lines, well vindicates the character of the Grayhound for intelligence, attachment, and sagacity, qualities which some, without any good reason, have denied to this noble race. [Dog.]

The Grayhound seems to have been a distinct variety of the Dog from a very early period in the history of this species. It exists at present in Egypt, and seems to be represented in the old Egyptian paintings. It is probable also that this was the form of dog with which the ancient Hebrews were best acquainted. We annex a representation of this dog from a drawing by Colonel Smith.

Arabian Grayhound.

GRAY-LAG. [Ducks.]

GRAYLING, a fish of the Salmon tribe, inhabiting many of the streams of England, in some of which it is abundant. It is also found in Sweden, Norway, and Lapland. [Salmonidæ.]

GRAYSTONE, a term proposed by Mr. Poulett Scrope to include certain volcanic rocks composed of felspar, augite, or hornblende, and iron; the felspar being sometimes replaced by leucite, or melilite.

GRAYWACKE. [Grauwacke.]

GREBE. [Colymbidæ.]

GREENBONE, two of the common Fish of our shores (the Gar-Fish (*Belone vulgaris*), and the Viviparous Bleny (*Zoarces viviparus*). [Belone; Zoarces.]

GREEN-FINCH. [Coccothraustes; Loxia.]

GREEN-IRON-EARTH, also called Hypochlorite, is a Mineral occuring in reniform, botryoidal, and globular masses. Its colour is green, passing into black and yellow. Lustre resinous and dull. Brittle. Found at Schneeberg in Saxony. The following is its analysis by Schular:—

Silica	50·24
Oxide of Bismuth	13·03
Alumina	14·65
Oxide of Iron	10·54
Phosphoric Acid with traces of Manganese	9·62
	98·08

GREENOCKITE, a Mineral, consisting of Sulphuret of Cadmium. It occurs crystallised in 6-sided prisms, with 6-sided pyramids. Hardness 2·75. Lustre vitreous, sometimes almost adamantine. Translucent to transparent. Specific gravity 4·842. Found at Bishoptown, Renfrewshire, and on the Cochuo-Burn, on the north side of the Clyde. The following is its analysis by Connell:—

Sulphur	22·56
Cadmium	77·30
	99·86

GREENOVITE, a Mineral, occurring in small amorphous crystalline masses. Primary form a doubly oblique prism. Colour deep rose-red. Hardness greater than that of fluor-spar; does not scratch glass. Some of the faces are brilliant, others often dull and tarnished. Specific gravity 3·44. It is found at St.-Marcel in Piedmont. Analysis, by M. Delesse:—

Silica	30·40
Oxide of Titanium	42·
Lime	24·30
Protoxide of Manganese	3·80
	100·50

M. Delesse observes that this mineral is analogous to *Sphene*.

GREENSAND. [Chalk Formation.]

GREENSHANK, the common name for a well-known Wading Bird, referred by some ornithologists to the Godwits; by others to the Snipes. [SCOLOPACIDÆ.]

GREENSTONE. Rocks in which felspar is combined with hornblende, or less commonly augite, the mixture being evident and the ingredients distinct, are usually called Greenstone. In such rocks the felspar is usually white or greenish, and less completely crystallised than in sienite; grains of pyrites frequently occur; the masses have a rude prismatic figure (Corygills, Isle of Arran); and by decay show a globular interior structure as in basalt. [BASALT.] If augite and hornblende be in effect the same mineral generated under different circumstances, and hypersthene be analogous, if not identical, it is perhaps probable that geologists may hereafter be disposed to adopt a suggestion of Dr. M'Culloch, and divide sienites, greenstones, and basalts according to the substance united with felspar, which is present in all. We shall then have hornblendic sienite, greenstone and basalt, augitic sienite, greenstone and basalt, hypersthenic sienite, greenstone and basalt, the distinctions between sienite, greenstone, and basalt being chiefly founded on the aggregation of the rock and the character of the felspar. The geological history of greenstone is very similar to that of basalt, and in the same tract of country one quarry may give fine-grained basalt and another distinctly marked greenstone. [ROCKS; BASALT; AUGITE; HORNBLENDE; TRAP.]

GRES. This French equivalent of the English word grit, or sandstone, includes several rocks, which may be thus noticed:—

Grès de Fontainebleau . . .	A tertiary rock.
Grès de Vienne Grès des Carpathes	Equivalent of the greensands.
Grès de Luxembourg . . .	Between the lias and the variegated marls.
Grès bigarré	Equivalent of the hunter sandstein (German,) and new red-sandstone (English).
Grès Vosgien . .	A local red grit rock on the flanks of the Vosges Mountains.
Grès rouge (Grès ronge) . . .	The sandstone below the magnesian limestone (termed rother sandstein in some parts of Germany, also called rothe todte liegende).
Grès houillier	Grits of the coal formation.

GRENGESITE, a Mineral, consisting of hydrous silicate of iron.

GREVILLEA, a genus of Proteaceous Plants named by Robert Brown in honour of Dr. Greville of Edinburgh.

GRE'WIA, a genus of Plants belonging to the natural order *Tiliaceæ*, so-named in honour of Dr. Grew, celebrated for his work on the anatomy of vegetables. Though the family takes its name from the European genus *Tilia*, its species are distributed chiefly through tropical countries. *Grewia* now consists of upwards of 50 species of moderately-sized trees or shrubs, which have leaves resembling those of the elm, yellow or white flowers, and many of them pleasant-tasted subacid fruit. The calyx consists of 5 coriaceous sepals, which are coloured internally. Petals 5, each provided with a gland or scale at the base, inserted with the numerous stamens into the elevated receptacle; germ superior, generally 2-celled; style single; stigma 4-lobed; drupe with from one to four 1- or 2-seeded small nuts. The species of *Grewia* are found in the tropical islands and the hot parts of the Old World, extending west to the west coast of Africa, and south to the Cape of Good Hope. In India they are common in every part, both in jungly forests and the dry open plains; some of the same species extend from the southern to the most northern parts; a few even ascend the Himalayas to moderate elevations. Species are also found in Arabia and Egypt.

The species of *Tiliaceæ* are noted for their mucilaginous properties, as well as for the remarkable tenacity of the inner fibre of their bark, as exemplified in the *Tilia*, or common European lime-tree: that of *Grewia oppositifolia* is employed for making ropes with in the Himalayas; and *G. elastica*, figured by Dr. Royle in 'Illustrations of Himalayan Botany,' t. 22, and called Dhamnoo by the natives, is valued for the strength and elasticity of its wood. Cattle are fed on the leaves of some species, as *G. didyma*, at moderate elevations in the Himalayas. The pleasant-tasted subacid fruit of several species is eaten by the natives of India, but principally used for making sherbet. *Grewia asiatica*, or *phalsa*, is that principally employed and cultivated in their gardens.

GRIAS, a genus of Plants belonging to the natural order *Myrtaceæ*. It has the tube of the calyx adhering to the ovarium; the limb small, 4-cleft, obtuse; the petals 4, coriaceous; the stamens numerous, inserted in a square disc; the filaments joined into 5 series at the base; the inner ones very short; the anthers kidney-shaped, small; the style wanting; the stigma cruciate, hidden in the incurved stamens; the fruit ovate, 8-furrowed, crowned by the calyx. There is but one species, *G. cauliflora*, the Anchovy Pear. It is a tall little-branched tree with very long oblong leaves, and large white flowers seated on short many-flowered peduncles. It is a native of subalpine districts of Jamaica in boggy places. The fruit is an ovate berry the size of an alligator's egg, and of a brownish russet colour, and is pickled and eaten in the same way as the mango. It is readily propagated by seeds, and the young plants must be kept in a moist heat. It grows best in a loamy soil, and may also be propagated by large cuttings placed under a hand-glass in heat.

(Don, *Dichlamydeous Plants.*)

GRIFFON. [VULTURIDÆ.]

GRILSE. [SALMONIDÆ.]

GRIMOTHEA. [GALATHEIDÆ.]

GRI'SLEA, a genus of tropical Plants belonging to the natural order *Lythraceæ*, or *Salicariaceæ*. The genus is characterised by having a tubular calyx, which is from 4- to 6-toothed; the petals, 4 to 6 in number, are inserted between the divisions of the calyx; the stamens, twice as many, arise from the bottom of the calyx, and have their long filaments extending with the style beyond its tube; the capsule is superior, 2-celled, many-seeded, and covered by the persistent calyx. The plants of this genus consist of shrubs, with opposite, very entire leaves, dotted on the under surface with dark-coloured glands. The peduncles are axillary and many-flowered; the flowers reddish-coloured. The species are not more than three in number, of which one, *G. secunda*, is found in the warmer parts of South America, and the others in India. *G. tomentosa*, the best known and most useful species, is found in the islands of the Indian Ocean, in China, and in every part of the continent of India, especially in the jungly tracts at the foot of its several ranges of mountains. In such situations its bright red calyx, retaining its colour till the seeds are ripe, gives the whole plant a very showy appearance, and points it out to the collectors of its flowers, which form an article of commerce. These are much employed by the natives of India for dyeing a red colour, and having some degree of astringency, are also employed in Indian medicine. The plant is known by the names of Dharee, Dhaee, &c., and the flowers by that of Dhaeephool.

GRISON. [VIVERRIDÆ.]

GRISTLE. [CARTILAGE.]

GRIT. Hard sandstones are called Grits in the north of England, and indeed many soft sandstones are so termed. In particular districts some distinctive terms are applied, as millstone-grit, red-grit, white-grit, grindstone-grit, &c. Almost universally in the north of England the term 'freestone' belongs to such gritstones as will work easily and to a good face; 'calliard' stones are intractable, close-grained, almost flinty grits; in Aldstone Moor, Cumberland, the term 'hazel' is given to some hard grits; at Newcastle the word 'post' signifies a 'bed,' and is generally associated with gritstone rocks.

In geology the most remarkable rocks to which the word grit is applied, are—the calcareous grit (in which however there is often little of calcareous matter), a part of the middle oolite formation; the millstone grit, which contains beds of quartz pebbles, and is altogether a coarse irregularly laminated rock. [SANDSTONE.]

GRÖFYRITE, a Mineral consisting of hydrous silicate of alumina allied to Halloysite. [HALLOYSITE.]

GROMWELL. [LITHOSPERMUM.]

GROSBEAK. [COCCOTHRAUSTES.]

GROSSULARIACEÆ, *Currant-Worts*, a natural order of Exogenous Plants, consisting of 2 genera and 95 species. The genera consist of shrubs, either unarmed or spiny. The leaves alternate, lobed, with a planted vernation, often with a membranous edge to the base of the petioles. Flowers in axillary racemes, with bracts at their base, rarely unisexual by abortion; the calyx superior, 4- or

Ribes Grossularia.

1, a flower magnified; 2, the ovary and styles, from which the calyx, petals, and stamens have been cut off; 3, a calyx laid open, to show the petals and the insertion of the stamens; 4, a transverse section of a fruit exhibiting the parietal placentation; 5, a longitudinal section of a seed, with the minute embryo at the end of the albumen.

5-parted, regular, coloured, imbricated, or somewhat valvate in æstivation; petals 5, minute, inserted in the throat of the calyx; stamens 5, inserted alternately with the petals, very short; ovary 1-celled, with 2 opposite parietal placentæ; ovules numerous, on short stalks, anatropal, style 2- 3- or 4-cleft. Berry crowned with the remains of the flower, 1-celled, the cell filled with pulp; seeds numerous, suspended among the pulp by long filiform cords; testa externally gelatinous, adhering firmly to the albumen, which is horny; embryo minute, with the radicle next the hilum.

Nothwithstanding the great dissimilarity in the appearance of these plants and Indian Figs, the two orders were formerly confounded, and are still accounted by many writers conterminous, chiefly on account of their both having inferior pulpy fruit and parietal placentæ. They are natives of the mountains, hills, and woods and thickets of the temperate parts of Europe, Asia, and America, but unknown in Africa. In North America they are particularly abundant, and on the mountains of Northern India they contribute to give a European character to that remarkable region. In the tropics of Asia and the South Sea Islands they occur in the form of *Polyosma*, a genus which derives its name from the excessive fragrance of its flowers.

To this order belongs the genus *Ribes*, of which the Gooseberry and Currant are different species. The Black Currant is tonic and stimulant, and has fragrant glands upon its leaves and flowers. [RIBES.]

GROSSULARITE. [GARNET.]

GROUND-HOG. [AARD-VARK.]

GROUND-IVY. [NEPETA.]

GROUNDLING. [COBITIS.]

GROUNDSEL. This commonest of annual weeds is the plant called *Senecio vulgaris* by botanists, which was originally a native of Europe and the north of Asia, but which has followed the steps of man in his progress of colonisation till it has established itself in almost every place where there is a European settlement. It forms one species in the largest genus of plants yet known, no fewer than five hundred and ninety-five others being distinguished by M. De Candolle in his 'Prodromus.' Although in the eyes of man a worthless weed, Groundsel contributes largely to the support of small birds, which feed upon its fruit, or seeds as they are commonly but incorrectly called. [SENECIO.]

GROUSE. [TETRAONIDÆ.]

GROUSE, RUFFED. [BONASIA.]

GRUB, a name applied to the chrysalis or pupa state of insects; it is also sometimes applied to the larva state. [PUPA.]

GRUIDÆ, a family of Birds, including those known by the name of Cranes, and closely allied to the *Ardeidæ*, a family embracing the Spoon-Bills, Herons, Bitterns, and Storks.

Willughby thus generally defines his section of Cloven-Footed Piscivorous Water-Fowl:—"These have very long necks; their bills also are long, strong, ending in a sharp point to strike fish, and fetch them from under stones or brinks: long legs to wade in rivers and pools of water: very long toes, especially the hind toe, to stand more firmly in rivers; large crooked talons, and the middle serrate on the inside, to hold eels and other slippery fishes the faster, or because they sit on trees. Lean and carrion bodies, because of their great fear and watchfulness." He makes the section to consist of the Herons, Bitterns, &c., Storks, "the *Ibis* of Bellonius" (Belon), and the Spoon-Bills.

Ray places at the head of the *Aves Aquaticæ*, the "*Fissipedes*" (Cloven-Footed), "quæ circa aquas versantur, iis tamen non innatant" (which haunt the waters, but do not swim in them). The first section of these, consisting of the "Maximæ, singulares et sui generis," contains the Cranes (*Grus*, including the *G. Indica* and *G. Balearica*, the *Jabirus*, the *Çariama*, and the *Anhima*). Then come the "Aves aquaticæ, fissipedes, piscivoræ, ranivoræ, et serpentivoræ," the Storks and the *Ibis nigra*. Next to these are arranged the *Ardearum* genus (Herons and Bitterns), and then the *Ardeæ Exoticæ*, including the Soco, &c., and the Spoon-Bills.

The Stork, the Heron, the Spoon-Bill, &c., with a heterogeneous crowd of other birds, are brought under Brisson's 17th order.

The genus *Ardea*, in the 12th edition of the 'Systema Naturæ,' embraces the Herons, the Bitterns, and the Cranes (including the Balearic Crane and the Demoiselle, *Anthropoides*); the Jabiru, Boat-Bill, and Spoon-Bill are generically distinguished under the names of *Mycteria*, *Cancroma*, and *Platalea*. They form part of Linné's 4th order, *Grallæ*.

Dr. Latham's 7th order, *Grallæ*, embraces the *Ardeidæ* and *Gruidæ* among the rest of the Wading Birds.

The same families are scattered through M. Lacépède's Oiseaux de Rivage (*Grallatores*).

M. Duméril's 5th order of birds, Échassiers (Waders), contains his 16th, 17th, 18th, and 19th families. The Oyster-Catcher is included in the 16th (*Pressirostres*, or Ramphostènes); the Open-Beak, Bec-Ouvert (*Anastomus* of Illiger), the Heron, the Stork, the Crane, the Jabiru, and *Ibis* (*Tantalus*), form the 17th family, the *Cultirostres*, or *Ramphocopes*. The Spoon-Bill and Boat-Bill belong to his 18th family, the *Latirostres*, or *Ramphoplates*.

Among the *Grallatores* of Illiger the *Herodii* contain the genera *Grus*, *Ciconia*, *Ardea*, *Eurypyga*, *Scopus*, *Cancroma*, and *Anastomus*. The genera *Tantalus* and *Ibis* form the *Falcati*, and *Platalea* is placed among the *Hygrobatæ*.

Cuvier's Échassiers comprehend the *Brevipennes*, the *Pressirostres*, the *Cultirostres*, the *Longirostres*, and the *Macrodactyles*.

The *Cultirostres* consist of the Cranes, the Boat-Bills, the Herons, the Storks, the *Jabirus*, the Ombrettes, the Open-Beaks, the *Tantali*, and the Spoon-Bills.

M. Vieillot's Échassiers are divided into two tribes: the 1st, the Di-tridactylous; the 2nd, the Tetradactylous. The 6th family of these Waders (*Latirostres*) consists of the Spoon-Bills and Boat-Bills; the 7th (Herodions) comprehends the Ombrette, the Open-Beak, the Herons, the Storks, the *Jabirus*, &c.; and the 8th (*Ærophones*), the Cranes (*Grus* and *Anthropoides*).

The *Ardeidæ* and *Gruidæ* are placed by M. Temminck under his 2nd family of *Gralles* (Waders).

In M. De Blainville's method the *Ardeidæ* and *Gruidæ* are comprehended under the Cicouiens, his 3rd family of *Grallatores*, and in the same method as further developed by M. Lherminier, the 23rd family (first sub-class, or Normal Birds) consists of the Cranes (*Grus* of Pallas); and the 24th family (same sub-class) of the *Herodii* of Illiger.

Mr. Vigors considers that the *Grallatores* are naturally divided into these five families:—*Gruidæ*, *Ardeidæ*, *Scolopacidæ*, *Rallidæ*, *Charadriadæ*; and he places the *Ardeidæ* in the normal group and the *Gruidæ* in the aberrant group. He remarks that the species that enter into the family of *Gruidæ*, most of which were comprised originally in the genus *Ardea* of Linnæus, are separated from the remainder of that group by their food, which is chiefly vegetable; by their manners, which approach nearer to those of the land-birds; and by the formation of their bills and feet, the former of which are more obtuse at the end, and the latter shorter than is observable in the true *Ardeæ*. In these characters, Mr. Vigors observes, as well as in their general appearance, more particularly with respect to their plumage, they have a near alliance with the *Struthionidæ*. *Psophia* [AGAMI] of Linnæus is the first genus of this family to which Mr. Vigors calls our attention. This genus, in the comparative shortness of the bill, is considered by Mr. Vigors to be connected with the *Anthropoides* of M. Vieillot, the Numidian Demoiselle; while he regards the Crowned Crane of Africa (the Balearic Crane of authors, *Ardea pavonina* of Linnæus) as uniting this genus to the true *Grus* of the present day. "If the genus *Dicholophus* of M. Illiger," continues Mr. Vigors, "be found to belong to the Wading Birds, of which I have little doubt, its situation will most probably be in the present family, to which it bears a nearer resemblance in plumage and general structure than to any other division of the order. In this case it will form a more immediate link than any group at present known in the family with the *Charadriadæ*, which meet it at the corresponding extreme of the order; its shorter and more elevated hind toe forming the passage between the fully tetradactyle foot of the *Gruidæ* and the tridactyle foot of the *Charadriadæ*." We have seen [ÇARIAMA] that the habits of *Dicholophus* are not those of the Wading Birds, although in the whole of the visceral arrangement a close affinity may be observed to the *Gruidæ*.

Mr. Vigors remarks further that Cuvier has noticed the union that takes place between the last groups alluded to by Mr. Vigors and those of the *Ardeidæ* by means of the genera *Aramus* of Vieillot and *Eurypyga* of Illiger. These, he observes, lead to the extensive assemblage of species contained under *Ardea* (Linn.) and *Ciconia* (Briss.), both of which groups are connected by their general form and habits, but differ by some minute yet strongly-marked generic distinctions. Intermediate between *Ardea* and *Ciconia* appear those forms which display so remarkable a dilatation of the bill, namely, *Cancroma*, *Phœnicopterus*, and *Platalea* of Linnæus. The two last of these groups, continues Mr. Vigors, are equally distinguished by a greater development of the membrane that connects the toes than is observable in the other Waders, which join them on each side; and in one of them, the *Phœnicopterus*, this character, he remarks, is carried so far to the extreme as to have occasioned some systematists to place the birds of that genus among the *Natatores*. [DUCKS.] "But," says Mr. Vigors in conclusion, "the whole of the family have a membrane more or less extensive at the base of the toes; and if we compare the feet of the common *Ciconia alba*, of the *Platalea*, and the *Phœnicopterus* together, we shall see a gradual increase of this membrane in extent until it reaches the extreme in the latter genus. Among the groups that are allied to *Ciconia* there are many that resemble it in general character, but deviate from it in the form of the bill. Among these we may particularise *Scopus* (Linn.), distinguished by its more compressed and furrowed mandibles; the *Mycteria* (Linn.), where the point of the bill turns upwards; and the *Anastomus* (Ill.), where the mandibles, united at the base and at the point, leave an open space in the centre. The genus *Tantalus* (Linn.) bears an evident affinity to the same group, and has consequently been united to it in the arrangement of every systematic naturalist. It differs chiefly by the downward curvature of the bill. To this genus may be united the *Ibis* of M. Lacépède, which, in its more slender bill, bears an affinity to *Eurypyga*, from whence we commenced our inquiries into the family." The same author unites the *Scolopacidæ* with the *Ardeidæ* by means of *Numenius* of Brisson, as approaching *Ibis* most closely in its bill.

Prince Bonaparte makes the *Herodii* the 3rd family of the order *Grallæ*, and includes under it the genera *Grus*, *Ciconia*, *Ardea*, and *Aramus*: his 4th family (*Falcati*) consists of the genera *Tantalus* and *Ibis*. ('Specchio Comparativo.')

Mr. Swainson ('Natural History and Classification of Birds,' vol. ii.) is of opinion that the *Ardeadæ*, or Herons, by means of the Cranes, show the strongest affinity to the Ostriches, and thus unite the rasorial with the wading order. "Nearly all the Cranes," writes Mr. Swainson, "are large birds, with short and powerless wings, long and frequently naked necks, and more terrestrial in their habits than any of their congeners. The beautiful genus *Phosphia* (*Psophia?*), if truly belonging to this family, is more of a gallinaceous than a wading bird." After referring to the genus *Anthropoides*, Mr. Swainson thus continues:—"The more typical cranes (*Grus*, Pallas) are large birds, few indeed in species, but dispersed over Europe, America, and Asia: they seem to prefer the seclusion and security of marshes, and feed both upon seeds, herbage, worms, and small reptiles. The *Ardeadæ*, or Typical Herons, differ from the last in being composed of birds decidedly carnivorous; they are known by a larger and more pointed bill, and by the superior length of the legs. The herons, as a whole, are the most beautiful of all the waders, not so much from the colours of their plumage as from the elegant crests and prolonged feathers which ornament nearly all the species. They build in societies, but generally feed and live solitary. Like the kingfishers and many of the fissirostral birds, the greater part watch for their prey from a fixed station: a sheltered nook by the side of a river, or a projecting rock by the sea-side, over deep water, frequently serves them as a convenient post; here they watch for passing fish, which they dexterously spear or transfix by their long and sharp bill. Some of these birds are of a gigantic size; others are very small, but have all a very long neck, covered more or less by strong and loose feathers. The Tiger-Bitterns (*Tigrisoma*, Swainson) are exclusively found in South America, but the true bitterns seem restricted to no particular climate. The Boat-Bills (*Cancroma*, Linnæus) differ most essentially from the herons, since they have a short and very broad bill, shaped something like a boat with its keel uppermost." [Boat-Bill.] . . "The Spoon-Bills (*Platalea*) show a different but a no less singular form of beak, from which their name has been derived. The Storks (*Ciconia*) are among the largest of the heron family, one species (*Ciconia gigantea*) measuring, when standing erect, near 5½ feet; they are social and useful birds, and from destroying vast numbers of reptiles and other vermin are encouraged in many countries to build on the habitations of man. The chin and eyes are bare of feathers, but in *Mycteria*, which possibly enters into this family, the greatest part of the head and neck is entirely bare: one species inhabits America, one Asia, and one Australia. The tufted umbre forms the African genus *Scopus*, and is the only species known; the plumage is particularly soft, and the back of the head furnished with a lax tuft of feathers: this is obviously allied to the Open-Bills (*Anastomus*, Ill.), a singular form, remarkable for a thick and very powerful bill gaping in the middle. . . These are the principal genera which appear to enter this family, of which the herons and cranes form the two most typical groups."

In the 'Synopsis' (same volume), Mr. Swainson places the *Ardeadæ* as the first family of the *Grallatores*, or Waders, with the following definition:—"Size large; bill long, conic, very hard, straight, and compressed; hind toe moderate, and placed on the same level as the thers." The family, according to this author, includes the following genera and sub-genera:—*Ardea*=*Ardea*, *Egretta*, *Butor* (Bitterns), *Tigrisoma* (Tiger-Bitterns), *Nyctiardea*, Swainson (Night-Herons); *Cancroma*; *Platalea*; *Ciconia* (including *Mycteria* as a sub-genus); *Hæmatopus*; and *Scopus*.

Species of the families *Gruidæ* and *Ardeidæ* are to be found in all the four quarters of the globe. They seldom occur in the very cold regions.

We now proceed to give the characters of the genera of *Gruidæ*:—

Grus (Pallas).—Bill of the length of the head or rather longer, strong, straight, compressed, the point in the form of an elongated cone, obtuse towards the end; lateral base of the mandible deeply channelled; base of the bill elevated. Nostrils in the middle of the bill, pierced through and through in the groove, and closed backwards by a membrane. Region of the eyes and base of the bill often naked, or covered with warty excrescences (mamelons). Feet long and strong, a large naked space above the knee; three anterior toes, the middle one united to the external by a rudiment of a membrane, interior toe divided, posterior toe articulated higher on the tarsus. Wings moderate; first quill shorter than the second, which last is nearly as long as the third, and that is the longest; secondaries nearest to the body, arched, or very long and subulate in some foreign species.

Bill of Common Crane (*Grus cinerea*).

In the greater part of the species the trachea of the male forms circumvolutions upon itself; in the other similar sinuosities occur in both sexes, which do not differ in external appearance. Moult once in the year. (Temminck.)

Grus cinerea. The general plumage is ashy gray; throat, front of the neck, and occiput, very deep blackish gray. Forehead and space between the eyes and bill furnished with black hairs; top of the head naked and red. Some of the secondaries arched, longer, and loose-barbed. Bill greenish-black, horn-coloured towards the point, and reddish at the base; iris red-brown. Feet black. Length from the bill to the end of the tail 3 feet 8 or 10 inches. The old birds have a large whitish space behind the eyes and along the lateral part of the upper portion of the neck.

Common Crane (*Grus cinerea*).

Young Birds before their second autumnal moult.—No nakedness on the top of the head, or the space hardly visible. The blackish ash-colour of the front of the neck and occiput non-existent, or only indicated by longitudinal spots.

This is the Γέρανος of the Greeks; *Grus* of the Romans; Grue and Grua of the Italians; Grue of the French; Grulla of the Spanish; Kranich and Aschgrauer Kranich of the Germans; Trane of the Danes; Goran of the Welsh; and Crane and Common Crane of the English.

The habits of the Crane are migratory and gregarious. Mr. Selby remarks that in its contour and gait it bears a considerable resemblance to some of the *Struthionidæ*, and that we are reminded of the ostrich by the long flowing plumes that overhang the tail. He is of opinion that through this and other families its affinity to the Rasorial Birds is readily traced; and he observes that in its internal conformation it differs very essentially from the more typical familes of the *Grallatores*, and that its strong and muscular stomach indicates a different general economy from that of the *Ardeidæ*. This is quite true; but whilst the Crane frequents open and cultivated lands for the sake of newly sown corn and seeds to be found in such tracts, it is far from averse to small testaceous mollusks, worms, frogs, and other reptiles. Temminck says that the nest is placed among the rushes, &c., and sometimes on the walls of isolated houses. The pale bluish-green eggs, marked with brown, are two in number.

Temminck states that this crane inhabits the marshy plains of the Oriental countries; that it is common in the north, migrates regularly in spring and autumn, is rare in its passage in Holland, and only in very severe winters. Asia is one of the tracts of country much frequented by it. Dr. Von Siebold notices it in his list of birds killed at Japan. Mr. Selby states that its equatorial migrations extend to India, Egypt, and other warm parts of Asia and Africa, but that it retires in summer to the northern and eastern parts of Europe to breed. The migrations are performed high in the air, and the progress of the flock may be traced by the loud cries of the birds when they are beyond the reach of sight. The nighttime is frequently chosen for these changes of locality. Prince Bonaparte notes it as very rare and accidental near Rome; Willughby however saw many of them in the poulterers' shops in winter. But it is in England that the alteration of the country by drainage and enclosure has caused perhaps the most remarkable absence of these fine birds. They were numerous in the time of our ancestors, and highly esteemed by them, both as objects of sport and as furnishing a dish fit for the table of princes. By 25 Henry VIII., c. 11, confirmed by 3 and 4 Edw. VI., c. 7, twenty pence was the forfeiture for each egg of the Crane taken and destroyed. Willughby says, "They come often to us in England;

and in the fen countries in Lincolnshire and Cambridgeshire there are great flocks of them; but whether or no they breed in England (as Aldrovandus writes he was told by a certain Englishman, who said he had often seen their young ones), I cannot certainly determine, either from my own knowledge or from the relation of any credible person." In Pennant's time he had come to the conclusion that the Cranes had forsaken our island. "A single bird," says he, "was killed near Cambridge about three years ago, and is the only instance I ever knew of the crane being seen in this island in our time." Dr. Latham mentions only four instances as occurring within his memory of the Crane having been met with in England. (Pennant, 'Brit. Zool.,' 1812.) Montagu and Dr. Fleming mention a small flock that visited Zetland in 1807, and Mr. Selby received information of one killed in Oxfordshire in December 1830. The Crane can now be only regarded as an accidental and rare visitant to our islands.

"The flesh is very savoury and well tasted, not to say delicate" (Willughby), and indeed it seems to have been highly prized in former days. At the intronazation of George Nevell, the archbishop above alluded to, 204 cranes were served, and in the Northumberland Household-Book the price of the Crane (Cranys) is marked sixteen pence. At the marriage-feasts also above mentioned, one of the items in the first is "9 Cranes, every Crane three shillings and four pence;" and in the second we find "Item for a Standert, Cranes 2 of a dish" for the second course; and in the expenses we find "Item, in Cranes 9 . . . 0*l.* 30*s.* 0*d.*" The long drooping feathers are valuable as plumes.

Anthropoides (Vieillot).—Mr. Bennett remarks ('Gardens and Menagerie of the Zoological Society') that the name of *Anthropoides,* conferred upon this genus by its founder, M. Vieillot, owes its origin to a mistaken reading of a passage in Athenæus, which the French academicians of the 17th century improperly applied to the Demoiselle, or Numidian Crane, regarding the resemblance to man implied by the term *Anthropoides* as a convincing proof that the *Otus* of the Greeks was a synonym of the bird, which they were themselves describing under the name of Demoiselle, from its elegant attitudes. "It is difficult however," says Mr. Bennett, "to conceive how these learned men, with M. Perrault at their head, could have stumbled on so gross a misapprehension; for the passages cited by them from the Greek and Roman authors prove beyond all question that the *Scops* and *Otus* of the former and the *Asio* of the latter were in truth nothing else than owls, and had consequently no connection with the Numidian Crane. M. Savigny, on the other hand, refers the latter bird to the *Crex* of Aristotle and other classical authors; but we must confess that we entertain considerable doubt of this opinion also. The scattered notices of the ancient *Crex* appear to us by far too scanty and indefinite to admit of their positive appropriation; and they combine moreover several traits which are quite irreconcileable with the identity of the two animals. With the exception of this distinguished naturalist, almost all the modern authors who have spoken of the Demoiselle have merely copied Buffon, who with singular inconsistency, at the same time that he corrects the error of synonymy into which the academicians had fallen, adopts all their quotations founded upon this very mistake. The truth is, that the real history of the bird cannot be traced with certainty beyond the period of M. Perrault's memoirs, in which it was for the first time described under the fanciful denomination which it has since attained." We have given this passage entire because the exemplary and industrious zoologist who penned it is, in our opinion, borne out in his observations, and because it conveys a good lesson of the danger of hastily appropriating Greek or Roman names to existing animals. Such an appropriation should never be made without the clearest evidence of the identity of the species. But however right Mr. Bennett may be, the term *Anthropoides* is now generally received by ornithologists as the generic appellation for certain species of cranes, and must be retained, the only question being what species should be arranged under it. The Demoiselle and the Balearic Crane were the only two species of *Anthropoides* (Vieillot), till a third and most elegant species, *Anthropoides Stanleyanus* (Vigors), *Anthropoides Paradisæus* (Bechstein), was added. Mr. Vigors would include the whole of these three species in the genus; but Mr. Bennett remarks that the discovery of that species, closely allied as it is to the Demoiselle, seems to determine the existence of that form as a distinct type, and to render it more necessary to isolate the Crowned or Balearic Crane (*Balearica pavonina, Ardea pavonina,* Linn.), under another generic name, *Balearica* (Brisson).

A. Virgo, Ardea Virgo of Linnæus, the Demoiselle, is about 3 feet 6 inches high measured to the top of the head: from the point of the bill to the tip of the tail it is about 3 feet in length. Upper part of the head light gray; sides of the head, neck, and depending breast-feathers, blackish; head and neck fully feathered. A tuft of pure white loose-barbed feathers, three or four inches long, directed backwards with a curvature downwards behind each eye. General tint slaty-gray; outer portions of all the quill-feathers dingy-black. Secondaries longer than the primaries, forming when the wings are folded dependent downward-curved plumes. Bill yellowish or flesh-coloured; iris reddish-brown.

The habits of the Demoiselle are migratory, and its food consists in great measure of grain and seeds, though it occasionally takes small fishes, mollusks, and insects. Gizzard muscular. The Demoiselle produced young in the menagerie at Versailles, and one which was hatched and bred there lived twenty-four years.

Demoiselle (*Anthropoides Virgo*).

Africa is the head-quarters of this bird. It has been observed in the north, along the Mediterranean, the west from Egypt to Guinea, in the interior, and in the south near the Cape of Good Hope. It has been killed in Nepaul, according to Mr. Gould; is found on the southern coasts of the Black Sea and Caspian, and has been observed at Lake Baikal. It is occasionally seen in Europe, and appears about Constantinople in October. At the inundation of the Nile great numbers arrive in Egypt.

A. Stanleyanus (so named by Mr. Vigors in honour of the late Earl of Derby, then Lord Stanley, President of the Zoological Society of London), *A. Paradisæus* of Bechstein, the Stanley Crane, is in its general plumage bluish-gray, the top of the tumid head, which is well covered with soft feathers, is whitish, and there is a brownish post-

Stanley Crane (*Anthropoides Paradisæus*, Bechstein).

ocular band; the irides are chestnut-black, and the points of the quills, tail, &c., are brownish-black. Length from the tip of the bill to the end of the tail 3 feet 6 inches. Mr. Vigors mentions particularly the greater length and development of the hallux in this species, in which character, he observes, the bird seems to be intermediate between *A. Virgo* and the more typical *Gruidæ.* He considers the

Balearic Crane as according with this species in this particular, and by the additional character of the naked cheeks and caruncle under the chin, as exhibiting a still nearer approach to the true *Grus*. *A. Virgo*, on the other hand, by the slight development of the hallux, appears to him to possess the nearest affinity of all the birds in the group to the *Charadriadæ*.

"In manners and gestures," says Mr. Vigors, "the *Anthropoides Stanleyanus* appears to conform most intimately with the Demoiselle, displaying the same delicacy and elegance of attitude, and the same majesty, together with the same graceful playfulness in all its movements. I once had the good fortune to see it when released from the place of its confinement and set at liberty into an adjoining yard; and it was scarcely possible to witness a scene of more grace and animation. The bird, when after a few movements it felt itself free, bounded into the air, and traversed the yard with singular velocity, and a peculiarity of motion which could neither be termed running nor flying: with its wings expanded, and its long quill-feathers streaming just above the ground, it sailed and swept along the open space without regard to the numerous spectators who watched its movements, luxuriating in all the buoyancy and excursiveness of new-felt liberty. I understand that it is particularly eager in its pursuit after insects, which it takes when they are upon the wing; and that they seem to be its natural and most acceptable food. We may readily conceive what myriads of winged creatures it would encircle within its wings as it swept along its native marshes, in the manner observed above, and which it would thus bring within the compass of its prey." ('Zool. Journ.,' vol. ii.)

This beautiful bird is an inhabitant of the East Indies.

A. pavoninus, Vieillot (*Balearica pavonina*, Brisson; *Ardea pavonina* of Linnæus), the Balearic or Crowned Crane, received its English and French common name from its being supposed to be the Balearic Crane of the ancients. Its height when full grown is about 4 feet. We select Mr. Bennett's description: "Its plumage is of a bluish-slate colour on the neck and on both surfaces of the body; the quill-feathers of the tail and the primaries of the wings are of a beautiful black; the secondaries, which extend beyond the base of the tail, of a bright and glossy-brown; and the wing-coverts pure white. The cheeks and temples are entirely naked, and are coloured of a bright rosy-red, which sometimes overspreads the whole of the naked surface, and sometimes is confined to a portion of it, the remainder in this latter case becoming perfectly colourless and of a dull white. Beneath the upper part of the throat a similar naked space is gradually developed, which terminates in a dependent fold of the skin, like the wattle of a turkey, but more uniform on its surface, and of a brilliant red. As this prolongation is not always met wit, it has been

Crowned Crane (*Anthropoides pavoninus*).

considered by some writers as a mark of sex; but of the two birds examined by the French academicians, the one possessed it and the other not, and yet both were females; it may therefore with greater probability be considered as the result of age. The fore part of the head is covered by a close tuft of short, smooth, even, velvety feathers of a deep black; and behind these rises a very remarkable crest, consisting of a large number of flat yellowish filaments, each twisted spirally on itself, fringed along its edges with a series of black-pointed hairs, and terminating in a blackish pencil. These filaments are of nearly uniform length, and measure 4 or 5 inches from base to tip. They take their origin from a roundish space on the back of the head, and expand equally at their extremities into a circle of considerably larger diameter than the head itself. The bill, legs, and feet are of a dusky-black; and the iris is remarkable for being almost destitute of colour. As in most of the birds of this family, the feathers of the lower part of the neck are long, narrow, and gracefully dependent over the breast."

This description is so good in the main that we have given it in the author's own words; but his observations with regard to the wattle require confirmation. Indeed, he himself, as secretary to the Zoological Society, subsequently brought under the notice of a meeting of its members, specimens from the Society's museum, of Crowned Cranes from Northern and from Southern Africa, with the view of illustrating the characters which distinguish as species the birds from those several localities. Their specific distinction, he stated, on the authority of Professor Lichtenstein, had been pointed out, nearly 30 years from that time, by the professor's father, who gave to the Cape bird the name of *Grus Regulorum*. This distinction had not however, Mr. Bennett remarks, been generally known among ornithologists, although to those connected with the Society it had for some time been familiar, from observation both of numerous skins and of living individuals. In the bird of North Africa, for which the specific name of *Pavoninus* will be retained, the wattle is small, and there is much red occupying the lower two-thirds of the naked cheeks: in that of South Africa the wattle is large, and the cheeks are white, except in a small space at their upper part; the neck also is of a much paler slate-colour than that of the North African species. Mr. Bennett added that the latter characters had been observed to be permanent in an individual presented to the Society in April 1829, from the collection of the late Marchioness of Londonderry, then still living at the Gardens. They existed also in both the individuals presented by Sir Lowry Cole.

Dr. J. E. Gray remarks, that the oval form of the nostrils in the Crowned Cranes, added to other distinguishing characters which had frequently been pointed out, might be regarded as indicating a generic difference between them and the Demoiselle and Stanley Cranes, in which the nostrils have the lengthened form usual in the genus *Grus*, a genus from which they scarcely differ, except in the comparative shortness of their bill. For the group including the Crowned Cranes the name of *Balearica* might, he thought, be retained, and that of *Anthropoides* be appropriated to the one comprehending *Anthropoides Virgo*, Vieill., and *A. Paradisæus*, Bechst. ('Zool. Proc.')

The species with the small wattle and other differences will, according to this proposition, stand as *Balearica pavonina*. It is a native of Northern and Western Africa.

The species with the large wattle, &c., will stand as *Balearica Regulorum*. It is found in Southern Africa.

These birds are presumed to be migratory; but little is known of them, except in captivity, to which the birds are easily reconciled, living in friendship with the domestic poultry, and other captives, and even, as we have heard, interfering to prevent disputes. In a state of nature they are said to frequent swampy places, and to subsist partly upon fishes, worms, and insects, and partly on vegetable substances. They run with the wings expanded, and with great rapidity. Their note is loud, trumpet-like, and hoarse. In the catalogue of the African Museum, one of the species, there called the Kaffir Crane, is said to be held sacred by the Kaffirs bordering upon the Cape Colony; and if one should happen to be killed, even by accident, a calf or young cow must be slaughtered as an atonement. Mr. Swainson ('Classification of Birds') notices specimens of *Ardea pavonina*, Linn., as having been brought to him when in Malta, from the little island of Lampidosa, where, he says, they are by no means scarce.

Our English readers will find most of the birds above described living in the Gardens of the Zoological Society in the Regent's Park, together with many others of this very fine family of birds.

The bird called the Adjutant Crane, belongs to the family *Ardeidæ*. It is the *Ciconia Argala* of naturalists. [CICONIA.]

GRUINA'LES, a name given by Linnæus to the natural order of Plants now called *Geraniaceæ*.

GRUMIXAMEIRA, a Plant belonging to the natural order *Myrtaceæ*, yields a fruit which is spoken of by Martius as excellent eating.

GRY'LLIDÆ (*Achetidæ*, Leach), a family of Insects belonging to the order *Neuroptera*. Distinguishing characters:—Thighs of posterior legs large; tibiæ armed with spines; abdomen terminated by two long and slender fleshy appendages; tarsi of the anterior and intermediate pairs of legs 3-jointed; antennæ usually long and cetaceous.

The three principal genera contained in this family are *Gryllus*, *Gryllotalpa*, and *Tridactylus*. In the genus *Gryllus* the anterior tarsi are simple; the labial palpi are short; the anal appendages are long and slender, thickest at the base and pointed at the apex; the elytra in the females are studded with minute nervures which cross each other in an oblique manner; in the males the nervures are less numerous and irregularly disposed; the wings are longer than the elytra, and when not in use are folded longitudinally; the females are furnished with a long ovipositor.

Gryllus domesticus (Linn.), the Common House-Cricket, affords an example of this genus. This insect is about three-quarters of an inch in length, and of a pale-brown colour, with blackish markings on the head and thorax. It is found throughout Europe; frequents houses, and prefers the vicinity of the fire. The male makes a shrill noise, which is caused by the friction of the elytra against each other. These insects are of nocturnal habits, take to the wing readily, and can leap a considerable distance. The wingless specimens are the larvæ, and those which have only rudimentary wings are the pupæ.

There is another species which is tolerably common in some parts of England and in various parts of the continent—the Field-Cricket, or Grasshopper (*G. campestris*, Linn.). This insect is of a larger size than the house-cricket, and of a black colour; the inner side of the hinder thighs is red, and the elytra are brown, with a yellowish band at the base. The field-cricket generally frequents dry sandy districts; it burrows in the ground and preys upon other insects. The female is said to lay about 300 eggs. *G. viridissimus* is the Common great Green Grasshopper. [LOCUSTA.]

The species of the genus *Gryllotalpa* are remarkable for the large size of the anterior pair of legs and their fitness for burrowing; these legs are very broad, and flattened, notched beneath at the extremity, and bear a great resemblance to the fore feet of the mole—hence the name of Mole-Cricket has been applied to them.

Gryllotalpa vulgaris (Lat.), the Mole-Cricket, is common in some parts of England, but appears to confine itself to particular districts. It is upwards of 2 inches in length and of a brown colour; the legs are yellowish. This insect excavates subterranean galleries of considerable extent, and in so doing throws up small mounds of earth, after the manner of its prototype, among the *Mammalia*. It is said to do much mischief in gardens and plantations by injuring the roots of plants. As yet it is doubtful whether these insects prey upon worms or other insects, or whether they feed upon roots. Latreille supposes the former to be the case. We understand that the Duke of Devonshire's grounds at Chiswick are much infested by this insect.

In *Tridactylus* the antennæ are short and 10-jointed; the tarsi are 3-jointed; the females have no distinct ovipositor, but the apex of the abdomen is furnished with four small appendages, of which the two upper are 2-jointed. In lieu of tarsi to the posterior legs there are some small moveable hooked appendages (three in the typical species); the elytra are shorter than the abdomen, and of a triangular form; the wings exceed the elytra in length.

The small insects belonging to this genus are highly interesting, not only on account of their peculiar structure, but also in their habits. The species as yet discovered are very limited in number, and have been found only in the south of Europe and in North Africa; they invariably live near the margins of rivers, lakes, or other pieces of water, and it appears essential that the soil should be damp and consist of fine sand. In this sand they burrow, first vertically to the depth of a few inches, and then they form numerous small horizontal galleries. In the construction of these galleries they are probably in search of food. Sand is eaten and voided by these insects, and it is supposed that they receive their nutriment from the minute animalculæ left in the sand by the retiring water. For a detailed account of the habits of these insects see 'Histoire Naturelle des Insectes,' by Messrs. Audouin and Brullé, tom ix. p. 192.

The genus *Repipteryx* of Mr. Newman ('Entomological Magazine,' vol. ii. p. 204) is closely allied to the last-mentioned insects. The species upon which that entomologist founded the genus is from Para in South America.

In the family *Gryllidæ* are also included the genera *Æcanthus*, *Phalangopis*, *Platydactylus*, *Sphærium*, and *Cylindrodes*. The species upon which the last mentioned genus is founded is figured in Griffith's Cuvier's 'Animal Kingdom—Insects,' vol. ii. pl. 131. It is remarkable for its slender and cylindrical form, but in many respects approaches the genus *Gryllotalpa*.

GRYLLOTALPA. [GRYLLIDÆ.]

GRYLLUS. [GRYLLIDÆ.]

GRYPHÆA, a genus of *Conchifera monomyaria* (Lam.) closely allied to the oyster, and very abundant in the secondary strata of Europe from the Lias upwards to the Chalk, but scarcely known in tertiary strata. [OSTRACEA.]

GRYS-BOC. [ANTILOPEÆ.]

GUACHA'RO BIRD (*Steatornis*, Humboldt; *Podargus*, Cuv., Temm.), a Bird which has been confounded with *Podargus*, but which, according to the account of its food and habits by Humboldt, and to the opinion of some ornithologists, may be considered a genus distinct from the true *Podargi*. It has the following generic characters:—Bill hard, horny, much wider than it is high, nearly equalling the head in length; upper mandible strongly bent downwards into a rather sharp hook, and armed near its middle with two small teeth. Nostrils linear, longitudinal, nearly closed by a plate placed half-way down the mandible; lower mandible rather slender, dilated at its base; gape considerable, and extending to the posterior part of the eye; base of the bill furnished with stiff hairs directed forwards. Feet short, weak, with four toes separated up to their base; claws arched and weak, not dentilated. Fourth quill longest. (Humboldt.)

Steatornis Caripensis, (Humb.), the Guacharo Bird, is the type of the genus. It is the size of a common fowl; plumage sombre, brownish-gray, mixed with small striæ and black dots; large white heart-shaped spots bordered with black on the plumage of the head and on the wing- and tail-feathers. The plumage of the back is without spots. Tail wedge-shaped.

Guacharo Bird (*Steatornis Caripensis*).

Baron Alexander de Humboldt, in his 'Personal Narrative,' gives a lively description of the locality and habits of this remarkable and useful bird, and we shall endeavour to select the chief points of his account.

The cueva, or cavern, of the Guacharo, and the coolness of the climate, give celebrity to the valley of Caripe. The people love the marvellous, and are never tired of discussing the subject of a cavern that gives birth to a river and is haunted by thousands of nocturnal birds, whose fat is employed in the Missiones for culinary purposes. The traveller on his arrival at Cumauá soon hears of the stone of Araya for the eyes—of the labourer of Arenas who gave suck to his infant—and of the cavern of Guacharo, said to be several leagues in length—even to weariness. The cavern, called by the natives 'a mine of fat,' is not situated actually in the valley of Caripe, but at the distance of three short leagues from the convent, towards the west-south-west, and it opens into a lateral valley terminated by the Sierra del Guacharo. Humboldt and his party, accompanied by the alcaids, or Indian magistrates, and the greater part of the monks of the convent, set out for the Sierra on the 18th of September; and they at first traversed for an hour and a half a narrow path towards the south, across a plain covered with beautiful turf. They then turned westward, tracing up a small river which issues from the cavern. The ascent continued for three-quarters of an hour, during which they went sometimes in the shallow water and sometimes between the torrent and a rocky wall, on a very miry and slippery soil. This part of the road, with its incumbrances of falling earth, scattered trunks of trees, over which the mules could hardly pass, and a profusion of creeping plants that covered the ground, was very fatiguing. When they arrived at the foot of the lofty mountain of Guacharo they were only 400 paces from the cavern, without yet perceiving the entrance. The torrent runs in a hollow excavated by the waters: and they went on under a ledge, or cornice, the projection of which prevented them from seeing the sky. The path winds like the river, and at the last turning they suddenly stood before the immense opening of the cave. Humboldt, who had already been familiar with caverns, confesses that the reality far exceeded his expectations.

The Cueva del Guacharo is pierced in the vertical profile of a rock, and the entrance is towards the south, forming a vault 80 feet broad and 72 feet high—an elevation but a fifth less than that of the Louvre. The rock surmounting the cavern was covered with trees of gigantic height, and all the luxuriant profusion of an intertropical vegetation. Our space prevents an enumeration of the beautiful and curious plants, among which the *Orchidaceæ* are not forgotten, recorded by the Baron, and dwelt on by him with a pardonable rapture; but it is worthy of observation, that this luxuriance penetrated even into the vestibule of the cave. The travellers saw with astonishment plaintain-leaved Heliconias 18 feet in height, the Praga Palm, and Tree Arums, follow the banks of the river even to the subterranean places. There the vegetation continues, as in the deep crevices of the Andes, half shut out from the light of day, nor does it disappear till a distance of 30 or 40 paces from the entrance. The party went forward for about 430 feet without being obliged to light their torches. Where the light began to fail, they heard from afar the hoarse cries of the Guacharo Birds. These birds quit the cavern only at nightfall, especially when there is moonlight; and Humboldt remarks that it is almost the only frugivorous nocturnal bird yet known. It feeds on very hard fruits, and the Indians assured him that it does not pursue either the lammellicorn insects or those *Phalænæ* which serve as food to the goatsuckers. He states that it is difficult to form an idea of the horrible noise made by thousands of these birds in the dark recesses of the cavern, whence their shrill and piercing cries strike upon the vaulted rocks and are repeated by the echo in the depths of the grotto. By fixing torches of copal to the end of a long pole, the Indians showed the nests of these birds 50 or 60 feet above the heads of the explorers, in funnel-shaped holes, with which the cavern-roof is pierced like a sieve.

Once a year, near Midsummer, the Guacharo cavern is entered by the Indians. Armed with poles they ransack the greater part of the nests, while the old birds hover over the heads of the robbers, as if to defend their brood, uttering horrible cries. The young which fall down are opened on the spot. The peritoneum is found loaded with fat, and a layer of the same substance reaches from the abdomen to the vent, forming a kind of cushion between the bird's legs. Humboldt here remarks that this quantity of fat in frugivorous animals, not exposed to the light, and exerting but little muscular motion, brings to mind what has been long observed in the fattening of geese and oxen. It is well known, he adds, how favourable darkness and repose are to this process. At the period above mentioned, which is generally known at Caripe by the designation of 'the oil harvest,' huts are built by the Indians, with palm-leaves, near the entrance and even in the very porch of the cavern. There the fat of the young birds just killed is melted in clay-pots over a brushwood fire; and this fat is named butter, or oil (manteca, or aceite), of the Guacharo. It is half liquid, transparent, inodorous, and so pure that it will keep above a year without becoming rancid. In the kitchen of the monks of the convent of Caripe no other oil is used, and Humboldt never found that it imparted a disagreeable taste or smell to the aliments. The quantity of very pure manteca collected does not exceed 150 or 160 bottles, each being 60 cubic inches; the rest, which is less transparent, is preserved in large earthen vessels: the whole hardly seems to correspond with the immense annual carnage of birds. The use of the Guacharo oil is very ancient, and an Indian family, bearing the name of Morocomas, pretend to be the lawful proprietors of the cavern, as descendants from the first colonists of the valley, and lay claim to the monopoly of the fat; but, when Humboldt wrote, the monks had taken care that their rights were merely honorary. The Indians were obliged, in conformity with the system of the missionaries, to furnish oil of Guacharoes sufficient for the church lamp; the rest, Humboldt was assured, was purchased from them. He observes that the race of Guacharo Birds would have been extinct long since if several circumstances had not contributed to its preservation. The natives, withheld by superstitious fears, seldom dare to proceed far into the recesses of the cavern. Humboldt had great difficulty in persuading them to pass beyond the outer part of the cave, the only portion of it which they visit annually to collect the oil; and the whole authority of the Padres was necessary to make them penetrate as far as the spot where the floor rises abruptly at an inclination of sixty degrees, and where a small subterranean cascade is formed by the torrent. In the minds of the Indians this cave, inhabited by nocturnal birds, is associated with mystic ideas, and they believe that in the deep recesses of the cavern the souls of their ancestors sojourn. They say that man should avoid places which are enlightened neither by the sun nor the moon; and "to go and join the Guacharoes" means to rejoin their fathers—in short, to die. At the entrance of the cave the magicians and poisoners perform their exorcisms to conjure the chief of the evil spirits. It appears also, as another cause of preservation, that Guacharo Birds inhabit neighbouring caverns too narrow to be accessible to man, and from these perhaps the great cavern is repeopled; for the missionaries declared that no sensible diminution of the birds had been observed. Young birds of this species have been sent to the port of Cumana, and have lived there several days, but without taking any food; the seeds offered to them not suiting them. The crops and gizzards of the young birds opened in the cavern contain all sorts of hard and dry fruits, which are conveyed to them by their parents: these are preserved, and, under the name of 'semilla del Guacharo' (Guacharo seed), are considered a celebrated remedy against intermittent fevers, and sent to the sick at Cariaco and other low localities where fever prevails. Our limits will not allow us to pursue Humboldt's description further; and we must content ourselves with referring the reader to the 'Narrative' for many interesting details respecting the cavern itself and the surrounding scenery, giving only in conclusion, the situation, elevation, and temperature of this extraordinary grotto.

The Cueva del Guacharo, then, is situated nearly in 10° 10′ lat., and consequently in the centre of the torrid zone. Its elevation is 506 toises above the level of the Gulf of Cariaco. Humboldt found, in the month of September, the temperature of the interior air in every part of it between 64° 6′ and 66° of Fahrenheit, and the external atmosphere 61° 2′. At the entrance, the thermometer in the air gave 63° 7′; but when it was immersed in the water of the little subterraneous river it stood, even to the end of the cave, at 62° 2′.

GUAIACUM, a genus of Plants belonging to the natural order *Zygophyllaceæ*, and inhabiting several of the West India islands, in low places near the sea. The most remarkable species is *G. officinale*, from which the hard compact black-green wood called Lignum Vitæ is obtained, which is so heavy that it sinks in water, and from which pestles, ship-blocks, rollers, castors, &c. are turned. This plant grows about twelve feet high, with round knotty branches. The leaves are equally pinnate, with about three pairs of opposite, smooth, roundish ovate or obovate oblique leaflets. The flowers are a beautiful bright blue, growing in small axillary clusters. The petals are oblong, downy in the inside, about three times as long as the sepals. There are ten stamens, and an ovate compressed ovary, which becomes an inversely heart-shaped succulent yellow capsule, with from two to five cells, and a single roundish compressed seed in each cell. This plant produces the gum-resin known in medicine under the name of Guaiacum, which is bitter, acrid, and stimulant, partly soluble in water, and wholly in alcohol. It is employed as a diaphoretic and alterative. [GUAIACUM, in ARTS AND SC. DIV.] The foliage is very detersive, and is used in the West Indies to scour and whiten floors, which it is said to do better than soap. Spike cylindrical, elongated; bracts 3-nerved. Flower rose-purple and fragrant. Pollen-cells open in front and below, stopped below by oblong glutinous valves quite distinct from the stigma, and to the broader ends of which the glands of the pollen masses are attached. It is found in hilly pastures.

Guaiacum officinale.
1, a magnified view of the stamens and ovary.

G. albida has a 3-lobed lip, the lobes unequal and entire, the middle lobe longest and broadest; sepals and lateral petals connivent, spur much shorter than the germen, root-knobs clustered. The stem is from 6 to 12 inches high; leaves oblong-obtuse, upper ones lanceolate-acute; the spike elongated, cylindrical; the wood, according to Hernandez, is internally blue. It is called in some of the West Indian Islands Bastard Lignum Vitæ.

G. arboreum is a large tree terminating in a beautiful head, with very hard wood, and is called by the natives of Cumana *Guaiacum*, but they give this name to all hard woods. The leaves have 7 to 14 pairs of oval-oblong blunt leaflets, which are unequal at the base, and are usually alternate, the petioles and branchlets somewhat pubescent; the petals unguiculate, and orange-coloured; the stamens with short appendages at their base; capsules stipitate, 5-winged.

GUAN. [CRACIDÆ.]

GUANITE, a native Phosphate of Magnesia and Ammonia, found by Teschemacher in Guano. It has a specific gravity of 1·5, and a hardness of 2·0. It occurs in brilliant rhombic prisms.

GUANO, the Peruvian name for the droppings of sea-fowl. In some of the islands off the coasts of America and Africa this substance has accumulated in such immense quantities as to have repaid the labour of collecting it and bringing it to Europe, where it is used as a manure. It is now universally admitted to be one of the most valuable of manures, and although it obtains a high price it is increasingly employed in the agriculture of Europe. One of the advantages of this manure seems to arise from the fact that it is produced by animals in which the excretions of both the kidneys and intestines are mixed together, and thus contains a large variety of those matters which are necessary to the existence of plants on which man feeds. The following analysis from Liebig's 'Chemistry in its Application to Agriculture and Physiology,' will give an idea of its ultimate constituents :—

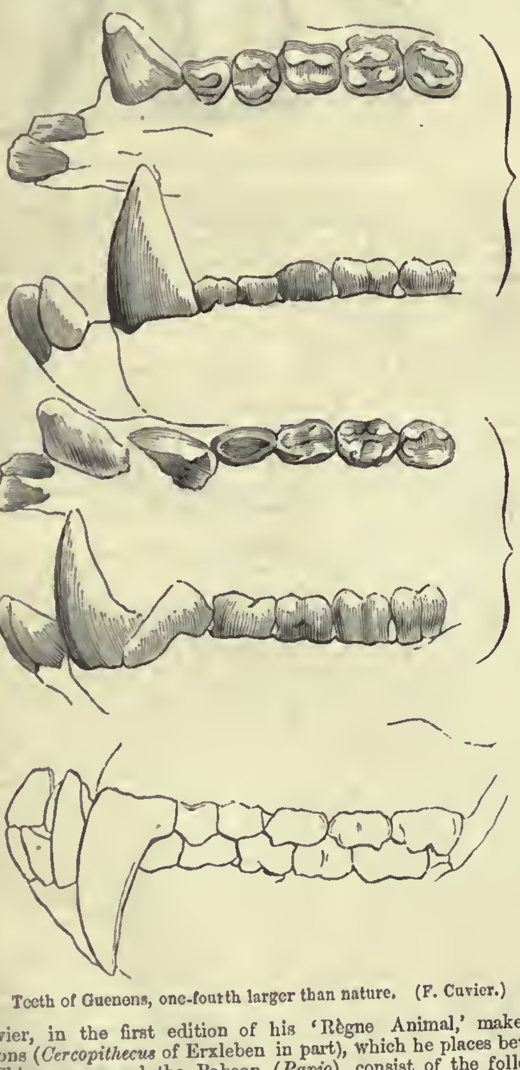
	Sample from Liverpool.	Sample from Lima.
1. Muriate of Ammonia	6·500	4·2
2. Oxalate of Ammonia	13·351	10·6
3. Urate of Ammonia	3·244	9·0
4. Phosphate of Ammonia	6·250	6·0
5. Waxy substance	0·600	,,
6. Sulphate of Potash	4·227	5·5
7. Sulphate of Soda	1·119	3·8
8. Phosphate of Soda	5·291	,,
9. Phosphate of Ammonia and Magnesia .	4·196	2·6
10. Chloride of Sodium	0·100	,,
11. Phosphate of Lime	9·940	14·3
12. Oxalate of Lime	16·360	7·0
13. Alumina	0·104	,,
14. Residuum insoluble in Nitric Acid .	5·800	4·7
15. Loss	22·918	3·3
	100·000	

GUAVA. [PSIDIUM.]

GUDGEON. [GOBIO.]

GUELDER-ROSE. [VIBURNUM.]

GUENONS, the French name for a group of Monkeys belonging to the ancient continent and its islands, the type of which may be considered to be the Green Monkey (*Cercocebus sabæus*, Geoff.).



Teeth of Guenons, one-fourth larger than nature. (F. Cuvier.)

Cuvier, in the first edition of his 'Règne Animal,' makes the Guenons (*Cercopithecus* of Erxleben in part), which he places between the Chimpanzee and the Baboon (*Papio*), consist of the following species :—*Simia Entellus*, Dufr.; *S. rubra*, Gmel.; *S. Æthiops*, Linn.; *S. fuliginosa*, Geoff.; *S. Maura*, Linn. (Gmel.?); *S. sabæa*, Linn.; *S. Faunus*, Gmel.; the *Mona* (*S. Mona* and *S. monacha*, Schr.); *S. Diana*, Linn.; *S. Cephus*, Linn.; *S. Petaurista*, Gmel.; *S. nictitans*, Gmel.; *S. Nasica*, Schr. (the Proboscis Monkey, or Kahau); and *S. nemæus*, Linn. (Gmel.?).

In his last edition of the same work he makes the group consist of *S. rubra*, *S. Æthiops*, *S. fuliginosa*, *S. sabæa*, *S. Faunus*, *S. erythropyga*, *S. melarhina*, the *Mona*, *S. Diana*, *S. Petaurista*, and *S. nictitans*, and he places these Guenons between the Gibbons (*Hylobates*, Illig.) and the *Semnopitheci*. M. F. Cuvier, in his 'Histoire des Mammifères,' had expressed his doubts of the propriety of placing the Entellus Monkey among the Guenons, and in his work 'Des Dents des Mammifères' (1825) had separated the *Semnopitheci* from them.

Mr. Swainson ('Classification of Quadrupeds,' 1835) excludes Man from the zoological circle, and makes the *Quadrumana*, Four-Handed Quadrupeds, the first order of the class *Mammalia*. Of this order the *Simiadæ*, Ape-Monkeys, form, according to him, the first family, which consist of—1, "*Simia* (Linn.), Oran-Outang," = *Simia*, *Troglodytes*, *Hylobates*, *Presbytes*, *Pithecus*; 2, "*Cercopithecus*, Pouched Monkeys," = *Lasiopyga*, *Semnopithecus*, *Colobus*, *Cercopithecus*, *Cercocebus*, *Nasalis*. The other genera are *Innuus*, *Macacus*, and *Papio*. In the table of 'Typical analogical Characters,' *Cercopithecus* is placed opposite to *Feræ*.

For Mr. Ogilby's arrangement, see CHEIROPODA.

In this article we shall confine ourselves to M. F. Cuvier's second division of the true Guenons.

Dental formula:—Incisors, $\frac{4}{4}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{5-5}{5-5} = 32$.

The true Guenons comprise the genera *Cercopithecus* and *Cercocebus* of Geoffroy. Nearly similar in manners and in their dentition, particularly with regard to their canine teeth, these genera appear to be naturally allied to each other, though the facial angle and more elongated muzzle, the large cheek-pouches, and shorter tail of the second sub-division (*Cercocebus*) seem to lead gradually to the baboons.

Cercopithecus.—Nearly allied to *Semnopithecus** [SEMNOPITHECUS] in form and manners, but differing from both *Semnopithecus* and *Cercocebus* not only in the development of the dentition, but in the size of the facial angle, which ranges from 50° to 55°, in the flat nose, in the rounded head, and long posterior extremities.

C. Mona, the Varied Monkey of Pennant, Le Singe Varié of Brisson, La Mone and Guenon Mone of Buffon and the more modern French zoologists.

Varied Monkey (*Cercopithecus Mona*). F. Cuvier.

Buffon is of opinion that this species is the Κῆβος of Aristotle, on what ground it is difficult to imagine, for Aristotle only says—'Εστὶ δ' ὁ μὲν κῆβος, πίθηκος ἔχων οὐράν—"the *Cebus* is a *Pithecus* (or Ape) having a tail." ('Hist.' lib. ii. c. 8.) Pennant indeed gives 'Κῆβος?' (with an interrogation) among the synonyms of the Varied Monkey; but in his text he shows that he was aware upon what slender data Buffon assumed its identity with the Κῆβος of the Greeks. Buffon refers also to Ludolf's curious account ('History of Ethiopia') as applying to this monkey, with as much probability as distinguishes his reference to Aristotle. "Of apes," says Ludolf, or rather his book 'made English by J. P. Gent' (1682), "there are infinite flocks up and down in the mountains themselves, a thousand and more together; there they leave no stone unturn'd. If they meet with one that two or three cannot lift they call for more ayd, and all for the sake of the worms that lye under; a sort of dyet which they relish exceedingly. They are very greedy after emmets. So that having found an emmet-hill, they presently surround it, and laying their fore

* Fossil remains of *Semnopithecus Entellus*, the Entellus Monkey, have been found in India.

paws with the hollow downward upon the ant-heap, as fast as the emmets creep into their treacherous palmes they lick 'em off with great comfort to their stomachs; and there they will lie till there is not an emmet left. They are also pernicious to fruit and apples, and will destroy whole fields and gardens, unless they be carefully looked after. For they are very cunning, and will never venture in till the return of their spies, which they send always before, who giving information that all things are safe, in they rush with their whole body, and make a quick dispatch. Therefore they go very quiet and silent to their prey, and if their young ones chance to make a noise they chastise them with their fists; but if they find the coast clear, then every one hath a different noise to express his joy. Nor could there be any way to hinder them from further multiplying, but that they fall sometimes into the ruder hands of wild beasts, which they have no way to avoid but by a timely flight, or creeping into the clefts of the rocks. If they find no safety in flight they make a virtue of necessity, stand their ground, and filling their paws full of dust or sand, fling it full in the eyes of their assailant, and then to their heels again." Such is the account upon the strength of which Buffon makes his reference; but that is not all, for the translation at least is graced by a large plate illustrative of these wonderful scenes, and there is not the vestige of a tail among the whole party of apes, twenty-six in number.

This species has the following characters:—Top of the head greenish-yellow mixed with a slight tinge of black; neck, back, and sides of a deep chestnut brown, passing downwards as far as the shoulders and haunches, where it changes into a dusky slate-colour continued on the limbs and tail, which last is considerably longer than the body, and has on each side of its base a remarkable white spot. Under surface of the body and inside of the limbs pure white, separated from the neighbouring colours by an abrupt line of demarcation. Naked upper part of the face, comprehending the orbits and cheeks, bluish purple. Lips, and so much of the chin as is without hair, flesh-coloured. On the sides of the face large bushy whiskers of a light straw-colour mixed with a few blackish rings advance forwards and cover a considerable portion of the cheeks. Above the eye-brows a transverse black band, extending on each side as far as the ears, and surmounted by a narrow crescent-shaped stripe of gray, which is sometimes scarcely visible. Ears and hands livid flesh-colour. (Bennett, 'Gardens and Menagerie of the Zoological Society of London,' vol. i.)

Mr. Bennett remarks that the name of Mona appears to be of Arabian origin, and is indiscriminately applied, under various modifications, by the Moors of Northern Africa to all the long-tailed monkeys without exception. From the language of the Moors, he observes, it has passed into those of Spain and Portugal, in both of which it has precisely the same signification. Mr. Bennett however does not agree with Pennant and Buffon, who consider it, in its Egyptian form of Monichi, to have been the origin of the English word monkey, which appears to him to admit of a much more obvious, though not very flattering derivation, from the parent-stock of our native tongue. He also expresses his doubts of the accuracy of Buffon in referring the *Cebus* of the ancients to this particular species, to which principally, on account of its being a native of the north of Africa, the latter has restricted the previously generic name of Mona.

Barbary is generally supposed to be the native place of this monkey. They are brought from Africa, and bear a European climate well, whence it is conjectured that they inhabit the north of Africa, or dwell in mountainous districts.

In a state of nature it is not known; for Ludolf's account, to which Buffon refers, cannot, as we have endeavoured to show, be applied with any degree of certainty to this species. M. F. Cuvier gives a very entertaining account of its manners in captivity. The individual which he figures and describes from the Paris menagerie appears to have been most amiable and intelligent, and to have been distinguished for its dexterity in unlocking chests or drawers, untying knots, searching pockets, &c. The individual in the possession of the Zoological Society from which Mr. Bennett's description was taken was capricious, savage in temper, and altogether of a worse character.

Cercocebus.—Resembling *Cercopithecus* in some points, but differing in others. Facial angle about 45°. Head inclined to the triangular form; muzzle rather lengthened; nose flat or convex; thumbs of the anterior hands slender, and placed near the fingers; those of the hinder extremities larger, and placed at a greater distance. Pygal callosities large.

It is the *C. sabæus*, Singe Vert, of Brisson; *Samia sabæa* of Linnæus; Green Monkey of Pennant; St. Jago Monkey of Edwards; Guenon Callitriche, and Callitriche, of the French zoologists.

It is greenish-yellow above, arising from the ringing of the hairs with various shades of yellow and black, but assuming more of a dark grizzled appearance on the sides of the body and outer sides of the limbs, which become gradually darker towards the hands. The face, ears, and naked parts of the hands jet black, the face triangular, bounded above the eyes by a straight line of stiff black hairs, and on the sides by spreading tufts of light hairs with a yellowish tinge, meeting in a point beneath the chin. Neck and chest white; under parts of the body of a yellowish tinge; inside of the limbs gray. Length of head and body 16 or 18 inches; that of the tail somewhat more. (Bennett, 'Gardens and Menagerie of the Zoological Society,' vol. i.)

In Adanson's 'Voyage au Senégal' will be found a good account of the habits of the species in a state of nature, and their silent and unflinching endurance of wounds and death from the gun. They associate in large troops, and are scarcely to be traced among the boughs except when they occasionally break some of them in their gambols, which are performed in silence, though marked by great agility. When shot at they make no noise, but gather together in companies, knit their brows, and gnash their teeth, as if they meant to attack the enemy. In captivity their disposition in general is not amiable, and they are considered captious and malicious; but, as Mr. Bennett observes, much of their character, as in other species, depends on their age and education.

Green Monkey (*Cercocebus sabæus*). F. Cuvier.

They are found in Africa (forests of Mauritania) and the Cape de Verd Islands. Edwards figured his specimen from an individual that was brought from St. Jago. Brisson appears to have been the first describer of the species from a specimen in the museum of Réaumur. Pennant says that it is also found in the East Indies, and that Sir Ashton Lever had his specimen from thence. [SIMIADÆ.]

GUEVI. [ANTILOPEÆ.]

GUEVINA. [XYLOMELON.]

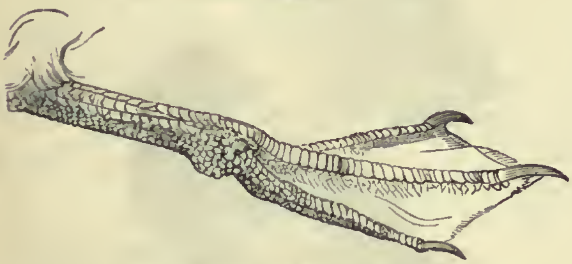
GUILLEMOTS, the common name of the species of *Uria*, a genus of Sea-Birds which some ornithologists place among the family of Divers, or *Colymbidæ*. Linnæus places the species *Grylle* and *Troile* at the head of his genus *Colymbus*. Cuvier arranges the genus under his family Plongeurs, or Brachyptères. Prince Bonaparte arranges them in the second section of his family Pygopodes, the genus *Colymbus* forming the first section. Lesson makes them belong to the family *Alcadæ*, which he seems to consider as synonymous with the Plongeurs of Cuvier.

Mr. Vigors, on leaving the *Colymbidæ*, enters the family of *Alcadæ* by means of the genus *Uria* (Briss.), which was originally included in the *Colymbus* of Linnæus, and from which, he observes, it has been separated chiefly on account of the tridactyle conformation of its foot. This character distinguishes the greater part of Mr. Vigors's group of *Alcadæ*, which, in addition to *Uria*, contains the genera *Alca* [AUK], and *Aptenodytes* [PENGUIN] of Linnæus. The latter genus, Mr. Vigors remarks, apparently carries to the extreme the typical character of those groups in which the wings, becoming gradually shorter, and less furnished with feathers, lose at length all their powers of flight, and assume the functions of fins, instead of wings, to assist the bird in its progress through the water. The whole of the family, united by the form of the foot, is separated into generic groups by the different shape of the bill. "And here," continues Mr. Vigors, "a beautifully progressive series of affinities is apparent throughout the whole group. Beginning from the true *Aptenodytes*, we may observe that the bill of that genus is long, rather slender, and somewhat curved; while that of *Catarrhactes* (Briss.), which succeeds, is shorter and more elevated at the ridge; thus leading the way to *Spheniscus* (Briss.), where the sides are compressed, and the culmen elevated into a sharp edge. This structure approaches the form of the same member in the true *Alca* [AUK], in which the sides are still more strongly compressed, and the culmen more elevated. The *Fratercula* (Briss.), the well-known Puffin of our rocky coasts [AUK], following *Alca*, exhibits the extreme of this singular construction; and there cannot be a more interesting subject of contemplation to him who may wish to witness the mode in which nature harmonises her groups, than the gradual change of form that unites the short and elevated bill of this last genus with the long aud slender bill of *Aptenodytes.* A similar gradation of affinities between conterminous groups leads us back again to the point from whence we started. Some species of the Linnæan *Alca*, which M. Temminck has united under the generic title of *Phaleris* [AUK], with bills less elevated at the culmen, and more tapering than that of *Fratercula*, lead us gradually to the *Mergulus* of Ray, the Little Auk of our cabinets. [AUK.] This genus, strongly and distinctively separated both from *Alca* and *Uria*, in the former of which groups it has been placed by Linnæus, and in the latter by M. Temminck, may be considered as intermediate between them. It thus brings us to *Uria*, where the pointed and tapering hill, again discernible, reconducts us to *Aptenodytes*." ('Linn. Trans.,' vol. xiv.)

Mr. Swainson, in the first part of the second volume of ths 'Classification of Birds,' appears to differ from Mr. Vigors, for he arranges the Guillemots, together with the Divers and Grebes, under the *Colymbidæ*. The *Alcidæ* (*Alcadæ*) include, according to the same author, the Penguins and the Puffins, and "all those singularly constructed groups where the wings are abortive, or in other words assume more the appearance, as they perform the office of fins;" but he remarks that the natural series of the genera have been commenced by some with *Uria;* by others, with some of ths *Alcæ*, or Pnffins. In the 'Synopsis' however, at the end of the volume, we find *Uria* the first genus of the 'family *Alcadæ:* Auks,' with the observation that the individuals in this group are so few that ths author has not considered it expedient to adopt the sub-genera, particularly as their natural series has not been marked out. The gencra which Mr. Swainson here places under the family *Alcadæ* are —*Uria*, Briss.; *Alca*, Linn.; *Mormon*, Ill.; *Chimerina*, Esch.; *Phaleris*, Temm.; *Aptenodytes*, Forst.

Uria.—Bill moderate, robust, straigbt, acnte, and compressed; upper mandible slightly curved towards the point; the lower mandibls forming an angle more or less open. Nostrils basal, lateral, concave, longitudinal, pervious, half shut by a large membrane covered with feathers advancing on the bill. Feet short, plunged as it wsre in the abdomen, so that the lower end of the tibia only is perceptible, and placed beyond the equilibrium of the body very far back; tarsi short, slender; three toes only, all anterior and entirely wsbbed: nails compressed, rather curved and sharp; wings short, narrow, and acute, the first quill longest; tail very short, rounded.

Bill of Common Guillemot (*Uria Troile*).



Foot of Common Guillemot (*Uria Troile*).

The Guillemots seem especially framed for existence in the arctic and even polar regions, and are seldom, comparatively, found in the warmer latitudes. In the north they swarm on all the rocks and islets of the chilling seas. In the short but bright summer that gilds some of their northern haunts, they make haste to deposit their eggs, sometimes only one, on the bare rock, without wasting ths precious days in making a nest. On the naked ledge that overhangs the sea the young Guillemot is hatched, and as soon as it is able to bear the shock, is conducted or rather tumbles from its hard nursery into the bôsom of the ocean, where a plentiful harvest is spread for it. Here the Guillemots are indeed in their element; plying their way with wings and feet beneath the waves and evsn beneath the ice, they make prey of the small fish and crustaceans, which form their principal food. Their native rocks or the ice-caverns shelter them from the storm, and it is only when the winter is mors than hyperboreally severe that soms of these species are driven for a temporary resort to more temperate climates. Their flight is sharp and rapid, though of no long duration, and generally directed just above the surface of the sea. The eggs, which are reckoned palatable, notwithstanding their fishy diet, are thick in the shell, which has a dull appearance.

Sir John Richardson notices *Uria* (*Mergulus*) *Alle* [AUK], among the species which merely winter in Pennsylvania, and migrate in summer to rear their young in ths Fur Countries—*Uria Brunnichii*, *U. Grylle*, and *U. Alle* in his list of birds detected in the North Georgian Islands and adjoining seas, iu 73° to 75° N. lat., on Sir Edward Parry's first voyage—and *U. Brunnichii*, *U. Troile*, *U. Grylle*, and *U. Alle* in the list of species common to the Old World and to the Fur Countries. *U. Alle*, *U. Brunnichii*, and *U. Grylle* occur in the list of 'Greenland Birds' by Col. Sabine.

In the table published by Sir John Richardson in 'Fauna Boreali-Americana,' the following interesting information is given :—

Species.	Extreme Northern range. Distribution in the Fur Countries. Whether resident or migratory.	Species that frequent the vicinity of Philadelphia. C. Bonaparte.	Winter Quarters of the Species.
	Lat. N.		
Uria Troile . . .	61°. Arctic Sea and Hudson's Bay.	Accidental visiter.	Principally at sea, in high latitudes.
Uria Brunnichii	75°. Arctic Sea and Hudson's Bay.	Accidental visiter.	Principally at sea, in high latitudes.
Uria Grylle . .	75°. Arctic Sea and Hudson's Bay.	Accidental visiter.	Principally at sea, in high latitudes.
Uria Alle . . .	75°. Arctic Sea and Hudson's Bay.	Winter. Rather rare.	United States.

Captaiu Sir James Ross ('Supplement to Sir John Ross's Last Voyage') says that *Uria Brunnichii* abounds in Baffin's Bay, and is found iu most parts of the arctic seas, and that he has also met with the species at Uist, ths northernmost of ths Shetland Islands, and in several parts of Scotland; but he observcs that it has always been confounded hy authors with *U. Troile*, which it so nearly resembles. He further states, that *Uria Alle* (Littls Guillemot, Little Auk of authors) collects during the breeding ssasou in vast numhers along the north and east coast of Baffin's Bay, but is seldom to be met with far to the westward of Lancaster Sound. A few were seen by the expedition near Leopold Island, and two or three specimens were obtained.

U. Troile, the Common Guillemot, Willock, or Tinkershere. Description of hoth sexes (old) in their winter dress.—Summit of the head, space between the eye and the bill, longitudinal band behind the eyes, and all the upper parts, of a velvety black slightly inclining to ash: all the lower parts and the extremity of the secondaries pure white: white is also found between the band behind ths eyes and the back of the nape, and advances towards the occiput, where it forms on each side an open angle. The ashy blackish colour of the lateral part of the neck seems to form towards ths breast a kind of collar, feebly indicated by bright ash. Bill ashy black; inside of the mouth livid yellow; iris brown; fset and toes yellowish-brown; posterior part of the tarsus and membranes black. Length from the bill to the claws rather more than 15 or 16 inches. N.B. The female is rather less than the male. In this stats Temminck, whoss description we have given, considers the bird to be *U. Suarbag* aud *Ringuia* of Brünnich; *Colymbus minor* of Gmclin; Lesser Guillemot of Pennant; Der Dumms Lumme of Bechstein; and Troillumme of Meyer.

Summer or Nuptial Plumage.—Head, region of the eyes, throat, and all the upper part of the neck of a velvety brown; inside of the mouth bright yellow: the rest of the plumage as in winter. Thus clad it is *Uria Lomvia* of Brünnich; *Colymbus Troile* of Linnæus and Gmelin; Le Guillemot of Buffon; Foolish Guillemot of Latham; Uria Maggiore, 'Stor. degl. Ucc.' (Temminck).

Young of the Year.—Principally distinguishsd from ths old birds in thcir winter plumage, by the comparativs shortness of the bill, which is ashy and yellowish at the hass; the black of the upper parts is clouded with ash-colour; the stripe or longitudinal band is not distinct, and mingles by means of ashy spots, with the white of the sides of ths occiput. Ashy-brown predominates on the lower parts of ths neck, and the white of ths lower parts is not so pure; the tarsi and toes are of a livid yellowish hue. It is then *Colymbus maculâ nigrâ pone oculos*, 'Sander. Naturf. Gmel.,' i. p. 584, va. *β*. (Temminck).

Accideutal Varieties.—No white on the secondary quills. M. Temminck states that hs killed an old Guillemot in ths spring, which had the whole of ths back and the caudal feathers mottled with yellowish-ashy stains.

This species is the Gwilym and Chwilog (the latter term applicable to ths stats in which Pennant calls it ths Lesser Guillemot) of the Welsh, and is called Willock in the South of Englaud, Skout iu Yorkshire, and Kiddaw in Cornwall. The number of provincial names is very great.

This bird is found in ths arctic seas of the Old and the New Worlds; migratory in winter iu largs companies along the coasts of Norway and England; very common at that tims along the shores of the Baltic and the maritime coasts of Holland and France; more rarely fouud "upon our seas aud great lakes of the interior." (Temminck.) Spitzbergen, Lapmark, and the White and Icy seas as far as Kamtschatka. Along the whole coast of Hudson's Bay, Labrador, and Newfoundland. (Nuttall.) The great body of the American birds of this species winter in the Bay of Fundy. (Audubon.)

In the British Islands they are numerous (among other localites) in the Orkneys, on the Bass Rock, the Farn or Fern Isles, the cliffs of Scarborough, the Needles and cliffs of the Isle of Wight, the Goodeve Rocks not far from St. Ives in Cornwall, and the Isle of Priestholm, contiguous to the Island of Anglesey, &c.

Common Guillemot (*Uria Troile*).
An adult and a young bird of the year.

The appellation of Foolish Guillemot has been given to this species from its often suffering itself to be taken by the hand or killed on the spot, especially in the breeding season, rather than quit the cliff it has chosen for its abode. The sea is the favourite resort of these birds when they leave their cliffs, and there they seek their food, consisting principally of small fish, small marine crustaceans, and small bivalves, diving with the greatest facility. They are with difficulty roused to flight. Early in April and May, or at the end of March, they begin to assemble on their favourite cliffs in Britain, and lay their single unprotected egg on the flat bare ledge of rock. This egg is generally of a pale green, blotched and stained with black and dark brown (umber). Sometimes the egg is white, with or without a few spots. It is a remarkable sight to see these birds, where they abound, sitting upon their eggs on their rocky shelves, often in line, and so close that they nearly touch each other. As soon as the young are capable of migrating, which is in August, or by the end of that month, they are said to disappear from our shores. Mr. Selby, whose obervations are always valuable, gives the following interesting account of these birds:—"Incubation lasts for a month, and when the young are first excluded they are covered with a thick down, of a blackish-gray colour above, and white beneath. This gradually gives place to the regular plumage, and in the course of five or six weeks from the time of hatching they are capable of taking to the water. During the time they remain upon the rock the parents supply them plentifully with the young of the herring and herring-sprats, which form the principal food of this and other species belonging to the *Alcadæ*. Upon the Northumbrian coast these Guillemots breed in great numbers on the Fern Islands, a locality that has afforded me ample opportunities of attending to their economy and watching the changes they undergo. They have selected the summits of three fine isolated pillars, or masses of 'whinstone' (trap-rock), that rise upwards of thirty feet above the level of the sea. Upon these the eggs are laid as close as possible, merely allowing room for the birds to sit upon them, which they do in an upright position. The appearance they make in a dense mass is curious, and the interest is increased by the number of Kittiwakes (*Larus tridactylus*) which hover around, and which breed in the small side clefts, or on the projecting angles of the rock; and by the nests of two or three Crested or Green Cormorants, which, from the unusual confidence they display in continuing to sit upon their eggs, even when overlooked from the opposite precipice at only a few yards' distance, seem to be well aware of the security of the station they have chosen. The great body of the breeding birds arrives towards the end of March, or the beginning of April, at which time most of them have acquired the perfect nuptial plumage. I have however obtained them much earlier, and when the white upon the throat was only giving place to the pitch-coloured black that distinguishes them till after the sexual intercourse. At this time they often lose so many of their quill-feathers as to be totally incapable of flight; but these are soon reproduced, and the colonies which had made the English coasts their summer quarters retire to more southern latitudes to pass the winter months. Their place in this country is but sparingly supplied by a few stragglers from the great bodies that, being bred in still higher latitudes, make the firths of Scotland and its isles the limit of their equatorial migration." ('Illustrations of British Ornithology,' vol. ii.)

Much cannot be said in favour of the flesh of the Foolish Guillemot, though the people of Kamtschatka kill numbers of those birds for food. The principal reason however for the attack upon them arises from the value of their skins as an article of clothing to the inhabitants of those cold regions. The eggs seem to be generally accounted delicacies.

U. Grylle, the Black Guillemot. Description of both sexes in complete winter plumage.—Summit of the head, nape, and all the upper parts, with the exception of the middle of the wings, of a rather deep black; the wing-coverts forming a large white space, or speculum. Cheeks and all the lower parts from bill to tail pure white; irides red.* Bill black; interior of the mouth and feet bright red. Length from bill to claws about 13 inches. In this state M. Temminck, whose description we have selected, says that *U. minor striata* of Brisson, *U. Baltica* and *U. Grylloides* of Brünnich, are individuals in different stages of moulting, passing from winter plumage to that of summer; that the Spotted Greenland Dove of Edwards ('Glean.,' t. 50) is a very exact figure of a moulting individual; and that the Spotted Guillemot of the 'British Zoology' and Latham ('Syn.') are varieties or different states of the autumnal and spring moults.

Black Guillemot (*Uria Grylle*).
An adult and a young bird.

Young of the Year.—Throat, breast, and the lower parts, white; summit of the head, nape, lower part of neck and sides of the breast, blackish, spotted with gray and white; back and rump of a dusky black, some of the scapulars and feathers of the rump terminated with whitish ash; wings black, with the exception of the speculum, which is white, but marked with ashy or blackish stains; inside of the mouth and feet livid reddish; iris blackish-brown.† In this state

* Temminck says brown; but Mr. Gould ('Birds of Europe') describes and figures them as red in the adult, and this we believe to be right.

† In our copy of Frisch the iris is coloured red. In Mr. Gould's 'Birds of Europe' the iris is brownish, inclining to olive, and the feet are yellowish-brown.

there is a very faithful figure of the bird in Frisch, 'Vög. Deutsch.,' t. 185 (Temminck).

Summer Plumage, or Nuptial Dress.—Male.—The whole plumage, the middle of the wing alone excepted, of a sooty-black; wing coverts forming a large space or speculum of pure white. Bill black, the inside of it and the feet bright red.

Female.—Rather less. The black of the plumage less deep, and the white of the plumage less extended and less pure. At the periods of the two moults white feathers in more or less quantity are visible on the under parts of both sexes. M. Temminck, who gives this description, refers to the following synonyms and works as illustrative of this state of plumage, and some of its stages: *U. Grylle*, Lath.; *Colymbus Grylle*, Gmel. (Linn.?); *Columba Grœnlandica*, Briss.; Le Petit Guillemot Noir, Buff.;* Black Guillemot, Lath. ('Syn.'); Penn. 'Brit. Zool.,' p. 138, t. H. 4, an individual preserving some of the feathers of its youth; Penn. 'Arct. Zool.,' p. 516, No. 437—Edw., 'Glean.,' t. 50.; Der Schwarze Lumme, Bechst., 'Naturg. Deutsch,' v. iv. p. 586—Meyer, 'Taschenb.,' vii. p. 446—Meyer, 'Vög. Deutschl.,' v. i.—Heft, 13, t. 3 and 4—Naum, 'Vög.,' t. 64, No. 6. f. 100, very old male.

M. Temminck remarks that the indications of the pretended species, *Cephus lacteolus* (Pallas, 'Spic.' v. 5, p. 33), which Latham has recorded as his *Uria lacteola* ('Ind.' v. 2, p. 798, sp. 3)—*Colymbus lacteolus* (Gmel.)—have reference to an individual in its winter plumage, accidentally variegated with white; and that this albino was obtained by Pallas on the maritime coasts of Holland.

Mr. Selby observes that from the short description given by Cuvier of his genus *Cephus*, in the 'Règne Animal,' it is evident that the Rotche, or Little Auk, of some of our writers (*Alca Alle*) is there considered to be its typical representative, and not the Black Guillemot; and, he observes, this appears still more evident from the note at the bottom of the same page, in which (after adverting to the figures of the Lesser and Spotted Guillemots in the second volume of Pennant's 'British Zoology,' pl. 83) Cuvier says, "Ces sont des Guillemots proprement dits. Au contraire, *l'Alca Allé*, Penn. ('British Zoology,' 11, pl. 82, 1; Albin, 1, 85), appartient aux *Cephus*." Mr. Selby goes on to remark that Dr. Fleming has however appropriated this generic term to the Black Guillemot, making the distinction between it and *Uria* to consist in the want of a terminal notch in the upper mandible; but as this character does not appear to be constant, Mr. Selby having seen some specimens with the notch, though not so fully developed as in the Foolish Guillemot, he has retained it in the situation where it was originally placed by Dr. Latham.

The note alluded to by Mr. Selby is in the first edition of the 'Règne Animal;' but in Cuvier's last edition (1829), which Mr. Selby does not appear to have seen, the note is omitted. In this edition the generic appellation "*Cephus* (Vulg. Colombes de Groenland)" is retained with the same characters, but the subsequent part is very much altered, for it stands thus in the last-mentioned edition:—"The species most known, called Petit Guillemot, or Pigeon de Groenland (*Colymbus minor*, Gm. Enl. 917; *Mergulus Alle*, Vieill., Gal. 295; 'Brit. Zool.' pl. H. 4, f. 1; Edw. 91; Naum. 1st ed. 65, f. 102), of the size of a good pigeon, is black above, white below, with a white mark on the wing as in the Guillemot. Its bill is black and its feet are red. It inhabits all the coasts of the north, and nestles under ground ('niche sous terre'). We see it also sometimes in winter." Notwithstanding the confusion in the passage just quoted, and some parts of the description, references, and alleged nidification which can hardly be made to apply to the Little Auk, or Rotche, it seems probable that Cuvier meant to take that bird, as Mr. Selby observes, as the type of his genus *Cephus*.

It is also called the Black Greenland Dove, Sea-Turtle, or Dovekey, by the northern voyagers; is the Sesekesewuck of the Cree Indians, and Gwylim dû Eas gan longwr of the Welsh.

It inhabits the same countries as *Uria Troile;* migratory during winter along the borders of the ocean; more rarely seen on land than *Uria Troile*, and then only by accident; very rare in the seas and lakes of the interior. (Temminck.) Widely distributed in the arctic circle, and met with in very high latitudes, inhabiting all the icy regions of Europe and North America. (Selby.) Abounds in the arctic seas and straits from Melville Island down to Hudson's Bay, and remains, though in diminished numbers, all the winter in the pools of open water, which occur even in high latitudes among the floes of ice. Small flocks extend their migrations, in that season, as far south as the United States. (Richardson.)

Mr. Selby observes that in the northern parts of Scotland and its isles this is a numerous species, but becomes of rarer occurrence as we approach the English coast, where indeed it is but occasionally met with. "Although Montagu," continues Mr. Selby, "has mentioned it as resorting to the Farn Islands, and Mr. Stephens has repeated the same, I can safely assert that this has not been the case for the last twenty-five or thirty years, having been in the habit of visiting this group of islands almost annually during that period; and had it been a visitant I feel confident it could not have escaped my observation, or that of the keepers of the lighthouse, who reside there. It certainly breeds, though in very small proportion, upon the Isle of May, at the mouth of the Frith of Forth, but is not found in large congregated numbers till we reach the vicinity of the Orkney and Shetland isles. In these parts it is resident throughout the year, never migrating to the same extent as the preceding species (*Uria Troile*) and the Razor-Bill Auk. Its habits are very similar to those of its congeners, and it is rarely seen upon land, except for the purpose of incubation. It breeds in the crevices or on the ledges of rocks, whence it can readily drop into the water or get upon wing, and lays a single egg, of a grayish-white, speckled with black and ash-gray. Its food consists of fish, *Crustaceæ* (*Crustacea*), &c." So far Mr. Selby, with whose accuracy as an observer we have often had occasion to be satisfied. Mr. Gould moreover speaks of its depositing on the ledges of the rocks "its single egg." We must however now let one of the most indefatigable observers speak for himself, more especially as his account differs so essentially from those above mentioned, and indeed from those of most other authors, except Nuttall. "Wherever," says Audubon, "there are fissures in the rocks, or great piles of blocks with holes in their interstices, there you may expect to find the Black Guillemot. Whether European writers have spoken of this species at random, or after due observation, I cannot say; all I know is, that every one of them whose writings I have consulted says that the Black Guillemot lays only one egg. As I have no reason whatever to doubt their assertion, I might be tempted to suppose that our species differs from theirs, were I not perfectly aware that birds in different places will construct different nests, and lay more or fewer eggs. Our species always deposits three, unless it may have been disturbed; and this fact I have assured myself of by having caught the birds in more than twenty instances sitting on that number. Nay, on several occasions, at Labrador, some of my party and myself saw several Black Guillemots sitting on eggs in the same fissure of a rock, where every bird had three eggs under it; a fact which I communicated to my friend Thomas Nuttall. What was most surprising to me was, that even the fishermen there thought that this bird laid only a single egg; and when I asked them how they knew, they simply and good-naturedly answered that they had heard so." The same graphic author addressing the reader tells him, in order to satisfy himself, to go to the desolate shores of Labrador. "There," continues the American ornithologist, "in the vernal month of June, place yourself on some granite rock, against the base of which the waves dash in impotent rage; and ere long you will see the gay Guillemot coming from afar by the side of its mate. They shoot past you on fluttering wings, and suddenly disappear. Go to the place; lay yourself down on the dripping rock, and you will be sure to see the birds preparing their stony nest, for each has brought a smooth pebble in its bill. See how industriously they are engaged in raising this cold fabric into the form of a true nest before the female lays her eggs, so that no wet may reach them from the constant trickling of the waters beneath. Up to the height of two or three inches the pebbles are gradually raised: the male stands by his beloved; and some morning when you peep into the crevice you observe that an egg has been deposited. Two days after you will find the number complete." ('Ornithological Biography,' vol. iii.)

Captain Sir James Ross, R.N., who in March 1823 shot near Igloolik the specimen described by Sir John Richardson, says that one individual only was obtained by the expedition during the winter, although several others were seen off Fury Point in February, 1833. It was, he adds, subsequently met with in great numbers as they travelled along the high precipitous land between Fury Point and Batty Bay, where the birds congregated in vast quantities during the breeding season, affording to the party many delicious meals, and proving a valuable addition to their then scanty stock of provisions. Several thousands were shot by their sportsmen; and by means of this providential supply of fresh food several of the men, who had been long afflicted with that most dreadful malady the sea-scurvy, were restored to health. Captain Sir J. Ross adds that it is not equal in flavour to *Uria Troile*, but is much more numerous and more extensively dispersed along the coasts of the arctic seas.

The species of this genus are but few. Speaking of *Uria lachrymans*, the Bridled Guillemot, Mr. Gould, in his 'Birds of Europe,' where it is beautifully figured, states that he is doubtful of its specific value, as it bears so close a resemblance to *U. Troile*, from which it differs only in the white mark which encircles the eyes and passes down the sides of the head. It inhabits the same localities as *U. Troile*, and is even often found in company with it on various parts of our coast, particularly in Wales, where Mr. Gould has been informed both kinds are equally numerous. He remarks that it was first described as distinct by Choris, who states that it is abundant at Spitzbergen and in the neighbouring seas; and adds that M. Temminck and the French naturalists consider these two *Uriæ* distinct.

U. Brunnichii, Brünnich's Guillemot, the Thick-Billed Guillemot. The distinctions of this species have been well pointed out by Colonel Sabine in his memoir on the birds of Greenland. It is at once distinguished at any season of the year from the Common Guillemot by the shortness, stoutness, regularity, and greater depth of its bill. It is on this account that it has been called the Thick-Billed Guillemot. This bird is recorded to have been occasionally seen in the British Islands. It has the habits of the Common Guillemot.

* M. Temminck speaks of Buffon's description as being correct, but not so the figure in the 'Planches enluminées' (917).

GUINEA-FOWL. [PHASIANIDÆ.]

GUINEA-PEPPER, the seeds of two species of *Amomum*, found on the west coast of Africa, within the tropics; the one, *A. grana Paradisi*; the other, *A. grandiflorum*. They are powerfully aromatic, stimulant, and cordial, and are used for the same purposes as Cardamoms.

GUINEA-PIG (*Cavia Cobaya*, Restless Cavy), the well-known Brazilian rodent now domesticated in Europe. [HYSTRICIDÆ.]

GUINEA-WORM. [ENTOZOA.]

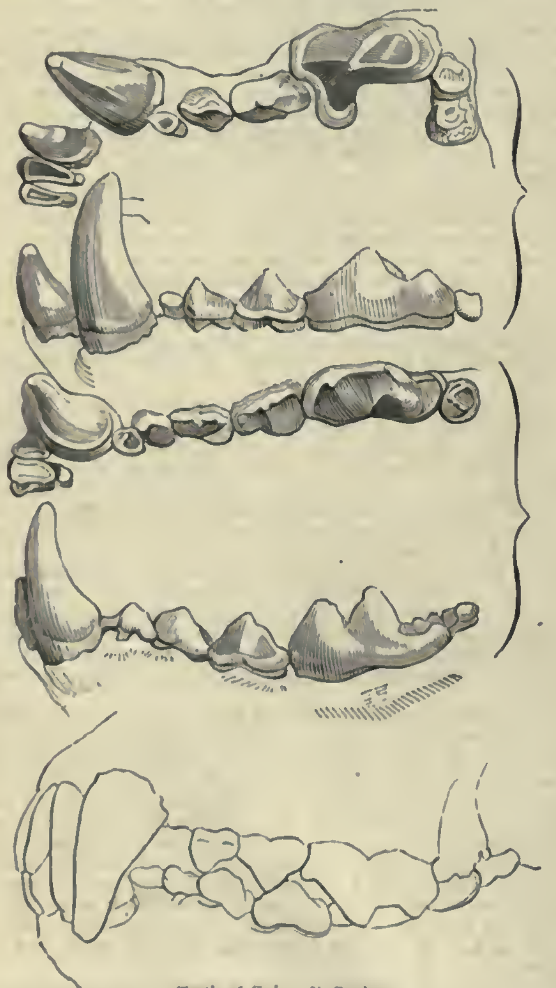
GULL. [LARIDÆ.]

GULO, the generic name under which the Glutton, or Wolverene, and the Grison (*Galictis* of Bell), with other Carnivorous congeners, have been arranged.

M. F. Cuvier, in the 32nd number of his 'Dents des Mammifères,' says that he might have treated of the Grison, the Tayra (*G. barbatus* of Desmarest), and the Glutton, in his preceding article, where he treats of the dentition of the Putois (*Putorius* of G. Cuvier), Zorille (*Zorilla*), and Martes (Martens); for he remarks, the dental arrangement of the Grison and Tayra resemble that of *Putorius*, and that of the Grison is similar to the formula observed in Martes. The two first, he states, have two false molars above and three below, and the last has an additional one in each jaw. For the rest, these animals have nothing in their teeth to distinguish them; that is to say, he continues, they have the same incisives, the same canines, and the same tubercular teeth. They have consequently all a relish for blood, and could not be separated from each other were it not for the plantigrade feet of the Grison, the Tayra, and the Glutton, an organisation which does not however change their propensities, and only leads to the modification of the means by which they satisfy their appetites.

The dental formula of the group has been stated as follows:—

Incisors, $\frac{6}{6}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{4-4}{5-5}$, or $\frac{5-5}{6-6}$, = 34 or 38.



Teeth of *Gulo*. F. Cuvier.

The well-developed carnivorous dentition, united with the plantigrade foot, seems to have thrown a difficulty in the way of zoologists, as to the proper place of these animals in a natural arrangement.

Linnæus placed the Quickhatch (*Ursus luscus*) among the Bears; but he appears to have considered the Glutton of the old continent not only as a different species, but as a different form, under the name of *Mustela Gulo*. This species is preceded by the *M. lutris*, *M. lutra*, *M. lutreola* and *M. barbara*—the latter the *Galera* of Browne, Jam. (?); and at the end of the description of *M. Gulo* Linnæus inquires whether all these species ought not to be referred to the genus *Viverra*. "Cum fata mihi denegarint præmissas species intueri vivas, videant alii numno ad Viverras referri debeant; hoc suadet Lutræ statura; hoc Gulonis fœtor, scansura arborum, summa laniena." ('Syst. Nat.,' ed. 12.)

Baron Cuvier (1817-1829) notices the position among the Bears assigned to the Glutton by Linnæus, but does not allude to its place among the *Mustelæ* of Linnæus, though he observes that the Gluttons approach more to the Martens in their dentition as well as in their general nature, while they only show their proximity to the Bears by their plantigrade feet. They have, he observes, three false molars above and one below in front of the carnivorous tooth (carnassière), and behind it a small tubercular tooth, which in the upper jaw is wider than it is long. The upper carnivorous tooth has only one small internal tubercle, and this, he remarks, is very nearly the dental system of the Martens. He concludes by stating that the Gluttons are animals with a moderate tail, with a fold under it in lieu of a pouch, and in other respects resembling the Badgers in their contour.

Dr. J. E. Gray ('Annals of Philosophy,' 1825) divides the *Ursidæ*, the second of his five families of the order *Feræ*, into five sub-families. The third of these sub-families, which he places in his second section (tubercular grinder 1—1 above and below), is *Gulonina*, and consists of the genera *Gulo*, Retz; *Galera*, Browne; *Grisonia*, Gray; and *Mellivora*, Storr.

M. Lesson (1827), in his 'Manuel,' arranges the genus *Gulo*, Retz, between the Badgers and the Ratel (*Mellivora*, Storr.); and he gives the following definition of the genus:—"Feet pentadactyle; two folds of skin, but no pouch near the vent; body more or less slender (effilé), more or less elevated on the legs; tail rather short." The dental formula stated by Lesson is the same as that above given.

Dr. Fischer (1829) places *Gulo* between *Mydaus* and *Ailurus*.

Mr. Swainson, in his 'Classification of Quadrupeds' (1835), says, "In its general appearance and physiology the Otter is not unlike the ordinary Polecats; and the resemblance is still further strengthened by the latter having semi-palmated or half-webbed toes, and occasionally frequenting the water in search of fish. On the other hand, the Grisson (Grison), *Gulo vittata* (*vittatus*), and the Taira, *G. barbara* (*barbarus*), now placed among the Gluttons, have their feet also semi-palmated; and, observes M. Cuvier, it appears they have sometimes been mistaken for otters. We may thus terminate the series of the *Mustelinæ* with the genus *Gulo*, which, although plantigrade, appears to have an affinity to the Polecats through *Lutra*, while at the same time it may open a passage to the Badgers and Bears." In the same page Mr. Swainson writes, "It will be a question for future investigation whether the Gluttons (*Gulo*), the Rattels (Ratels), *Ratelus*, and the Badgers (*Meles*), form the aberrant portion of the Ursine circle, or whether they merely represent the Bears, and enter into the circle of the *Mustelidæ*. For the present we may consider the two last in the former light, and thus pass onward to the sub-family of *Ursinæ*, typically distinguished from all others of the *Mustelidæ* by their great size, their omnivorous diet, and their short tails." In the third part of the work, "the class *Mammalia* arranged according to its natural affinities," *Gulo* is placed among the *Mustelinæ*, a sub-family which is preceded by *Viverinæ* (*Viverrinæ*?), and followed by *Ursinæ*.

The species of *Gulo* noted by Cuvier are:—1, the Glutton (*Ursus Gulo*, not of Linnæus, as Cuvier quotes it, but of Pallas and Gmelin) of the old continent, which, Cuvier observes, does not appear to differ from the Glutton of North America (*Ursus luscus* of Linnæus); 2, the Grison (*Viverra vittata*, not, as Cuvier quotes it, of Linnæus, who has no such species of *Viverra* in his last edition of the 'Systema Naturæ,' but of Gmelin); and 3, the Taira, or Tayra (*Mustela barbara* of Linnæus).

Lesson admits the following species of *Gulones*:—*G. arcticus* of Desmarest; *Ursus Gulo*, Linn. (Gmel.), &c., the Glutton, with *Ursus luscus*, Linn., as a variety; *G. vittatus* of Desmarest; *Viverra vittata*, Linn. (Gmel.), &c., the Grison; *G. barbatus* of Desmarest; *Mustela barbata* (*barbara*), Linn.; the Taira, or Galera, Grand Furet, of D'Azara; and *G. orientalis* of Horsfield, Nientek of the Javanese.

Dr. Fischer makes the recent species consist of *G. arcticus*, Desm., *G. vittatus*, Desm., *G. barbatus*, Desm., *G. lanatus* and *G. Capensis*, Desm. (the Ratel), observing that this last would be better removed to a distinct genus, and making this general remark on the whole generic assemblage—"Genus e speciebus nimis heterogeneis uti videtur conflatum." In his addenda he introduces *G. larvatus*, Temm. and Hamilton Smith, and *G. ferrugineus*, Hamilton Smith.

The Grison has been separated into a genus, named *Galictis* by Mr. Bell, and *Grisonia* by Dr. Gray, who also distinguishes the Tayra generically under the name of *Galera*, Browne; and observes, on the occasion of defining his genus *Helictis* ('Zool. Proc.,' 1831), that the *Gulo orientalis* of Dr. Horsfield's 'Zoological Researches in Java' appears to him to form a second species of the genus.

Pallas, and after him Pennant, who both arranged the form among the Bears, treat the Glutton of the old and that of the new continent as identical; and indeed zoologists seem now to agree in coming to that conclusion, but the synonyms afford good evidence of the difference of opinion that has prevailed with regard to its proper position.

The Glutton (*Gulo luscus*) is the Carcajou of La Hontan and the French Canadians; Quickhatch (*Ursulo affinis Americana*) of Catesby (Carolina); Quickehatch of the English residents at Hudson's Bay; Quickhatch, or Wolverene, of Ellis; Wolverene of Pennant; Wolverin, Quiquihatch, or Carcajou, of Graham (manuscripts); Kablee-arioo of the Esquimaux of Melville Peninsula; Kā ŏ wēēk of the Esquimaux of Boothia Felix; Naghai-eh of the Chippeways; Ommeethatsees, Okeecoohagew, and Okeecoohawgees (whence, as Sir John Richardson observes, the term Quickhatch of the European labourers in the service of the Hudson's Bay Company is evidently derived), of the Crees, or Algonquins; Rosomak of the Russians; Jarf, Filfress, of the 'Fauna Suecica'; Timmi of the Kamtschatkans; Haeppi of the Koratzki; Glouton of the French; *Gulo* of Olaus Magnus; *Gulo*, Vielfrass, of Gesner; *Hyæna* and *Ursus Freti Hudsonis* of Brisson; *Mustela Gulo* and *Ursus luscus* of Linnæus; *Ursus Gulo* of Pallas and Gmelin; *Taxus Gulo* of Tiedemann; *Gulo arcticus* of Desmarest; *Gulo vulgaris* of Griffith's Cuvier; *Gulo luscus* of Sabine.

Wolverene, or Glutton (*Gulo luscus*).

Olaus Magnus seems to have heen the source whence most succeeding writers have drawn their marvellous accounts of the Gluttou, setting forth its cruel and destructive powers, its inordinate voracity, aud the means which it adopts for filling itself till it is ready to burst, aud for getting rid of the load which it has swallowed. Buffon, who, too prone to censure other writers, and even nature herself, appears to have had almost the appetite of a Pliny for every wonderful tale, eloquently presents the relations of the older writers, not forgetting Ysbrandt, describiug the Glutton as a ferocious animal, prompt to attack the larger quadrupeds, and even fearlessly approaching man. He tells us that the wily heast supplies the want of swiftness by the extraordinary degree of cuuning which it manifests in surprising its prey; he relates how it will climb a tree, and there lie in ambush for the elk and the rein-deer, pouncing on their backs as they pass unsuspiciously beneath, and adhering so firmly by its claws, that all efforts to dislodge the grim rider hy the tortured and terrified animal are vain. Nor is this all; it is said even to bait the ground by throwing down the moss which is so favourite a morsel with the reindeer, to lure that animal to its destruction. So much for legends. Turn we now to the accouuts of actual ohservers. Sir John Richardson remarks that this character of the Glutton seems to be entirely fictitious, and to have partly originated in the name of Glutton having been given occasionally to Lynxes and Sloths, adding, after recapitulating it, that it is very dissimilar to the habits of the American Wolverene.

Buffon's name of the 'Quadruped Vulture,' as applicahle to the Glutton, has more foundation in fact, for it appears to prey occasionally at least upon the dead bodies of quadrupeds; but so much cannot be said for his repetition of the assertion that the beast will approach man without fear—unless indeed it is sorely pressed by hunger.

Sir John Richardson states that the Wolverene feeds chiefly upon the carcasses of beasts which have been killed hy accident, that it has great strength, and that it annoys the natives hy destroying their hoards of provision, and demolishing their marten traps.

Mr. Graham in his manuscripts informs us that the Wolverenes are extremely mischievous, and that they do more damage to the small fur trade than all the other animals conjointly. They will, he states, follow the marten-hunter's path round a liue of traps extending 40, 50, or 60 miles, and render the whole unserviceable, merely to come at the baits, which are generally the head of a partridge or a bit of dried venison. They are not fond of the martens themselves, but never fail of tearing them in pieces or of burying them in the snow hy the side of the path, at a considerable distauce from the trap. Drifts of snow often conceal the repositories thus made of the martens at the expense of the hunter, in which case they furnish a regale for the hungry fox, whose sagacious nostril guides him unerringly to the spot; and two or three foxes are often seen following the Wolverene for this purpose.

Such is Mr. Graham's interestiug and, we helieve, faithful account of the habits of the Wolverene. May not the attendant foxes have given rise to the story that the arctic fox is the jackal, or provider of the Glutton?

Sir John Richardson says of the Glutton, "It is so suspicious, that it will rarely enter a trap itself, but hegiuning behind, pulls it to pieces, scatters the logs of which it is huilt, and then carries off the bait. It feeds also on meadow mice, marmots, and other rodeutia, and occasionally on disabled quadrupeds of a larger size. I have seen one chasing an Americau hare, which was at the same time harassed by a snowy owl. It resembles the bear in its gait, and is not fleet; hut it is very industrious, and no doubt feeds well, as it is generally fat. It is much abroad in the wiuter, and the track of its journey in a single night may be often traced for many miles. From the shortness of its legs, it makes its way througu loose snow with difficulty, but when it falls upon the beaten track of a marten-trapper, it will pursue it for a long way." ('Fauua Boreali-Americana.') The same author remarks that the Wolverene is said to bc a great destroyer of beavers, but that it must be only in summer, when those industrious animals are at work on laud that it can surprise them; for an attempt to break open their house in winter, even supposing it possible for the claws of a Wolverene to penetrate the thick mud-walls when frozen as hard as stone, would only have the effect of driving the beavers into the water to seek for shelter in their vaults on the borders of the dam. He further tells us that though the Wolverene is reported to defend itself with boldness and success against the attack of other quadrupeds, it flies from the face of man, and makes but a poor fight with a hunter, who requires no other arms than a stick to kill it.

Captain Sir James Ross (Appendix to Sir John Ross's 'Last Voyage') gives a striking narrative of the holdness of the species when urged by famiue. The incident happened at Victoria harbour. "There," writes the gallant captain, "in the middle of the winter, two or three months before we abandoned the ship, we were one day surprised hy a visit from one, which, pressed hard by hunger, had climbed the snow-wall that surrounded our vessel, and came boldly on deck, where our crew were walking for exercise. Undismayed at the presence of twelve or fourteen men, he seized upon a canister which had some meat in it, and was in so ravenous a state that whilst busily engaged at his feast he suffered me to pass a noose over his head, by which he was immediately secured and strangled. By discharging the contents of two secretory organs, it emitted a most iusupportable stench. These secretory vessels are about the size of a walnut, aud discharge a fluid of a yellowish-brown colour, and of the consistence of honey, by the rectum, when hard pressed by its enemies."

The Wolverene produces youug once a year, in numher from two to four, and the cubs are covered with a downy fur of a pale cream colour. (Richardson.)

It is found throughout the whole northeru parts of the American Continent, from the coast of Labrador and Davis's Straits to the shores of the Pacific and the islands of Alaska. It eveu visits the islands of the Polar Sea, its bones having been found in Melville Island, nearly in latitude 75°. It is not rare in Canada. The extent of range to the southward is not mentioned by American writers. (Richardson.)

Sir James Ross remarks that some traces of the existence of the Wolverene iu the highest northern latitudes were observed on two of the Arctic expeditions: but none of the animals were seeu on those occasions; although, he observes, we know that it remains throughout the wiuter as far uorth as 70° N. lat., and is not, like other auimals of that rigorous climate, subject to any change of colour from the intense cold. A few days previous to the arrival of the Esquimaux near Felix Harbour, in January 1830, the tracks of this auimal were first seeu; aud soon after the skins of two old and two young ones were hrought to the ship by the natives, who had taken them in traps huilt of stone. During each of the following wiuters their tracks were occasionally seen, and at Victoria Harbour they were very numerous.

Pennant notes it as iuhabiting Lapland, the northeru and eastern parts of Siberia, and Kamtschatka.

Lesson states that it inhabits a complete circle round the north pole, in Europe and Asia, as well as America.

We have seen what mischief the Glutton does to the trapper, and the skin of the animal does not compensate for its destructive habits. Pennant says that the skin sold in Siberia for four or six shillings; at Yakutsk for twelve shillings; and still dearer in Kamtschatka, where the women dress their hair with its white paws, which they reckon a great ornament. The fur, he adds, is greatly esteemed in Europe, and he remarks that the skins of the north of Europe and Asia, which are sometimes to be seen in the furriers' shops, are infinitely finer, blacker, and more glossy than those from America. Sir John Richardson says that the fur of the American Glutton bears a great similarity to that of the black bear, but that it is not so long nor of so much value.

The head of this animal is broad and compact, suddenly rounded off on every side to form the nose; jaws resembling those of a dog in shape; back arched; tail low and bushy; legs thick and short: whole aspect indicating strength without much activity. Fur generally dark-brown, passing in the height of winter almost into black. A pale reddish-brown band, more or less distinct, and sometimes fading into soiled brownish-white, commences behind the shoulder, and running along the flanks turns up on the hip and unites with its fellow on the rump; the short tail thickly covered with long black hair; some white markings, not constant in size or number, on the throat and between the fore legs; legs brownish-black; claws strong and sharp.

Sir John Richardson, from whose work ('Fauna Boreali-Americana') the above description is taken, adds that the animal places its feet on the ground much in the manner of a bear, and imprints a track on the snow or sand, which is often mistaken for that of the bear by Europeans on their first arrival in the Fur Countries; but the Indians distinguish the tracks at the first glance by the length of the steps. It has the following dimensions:—

	Feet.	Inches.
Length of head and body	2	6
Length of tail (vertebræ)	0	7
Length of tail with fur	0	10

The Grison, *Gulo vittatus* of Desmarest, *Viverra vittata* of Schreber and Gmelin, *Lutra vittata* of Traill, *Ursus Brasiliensis* of Thunberg, and *Galictis vittata* of Bell. The anatomy of this animal has been made known to us by Mr. Martin, who, in the 'Zoological Proceedings' for 1833, states the results of the post mortem examination of a male which had been kept in the Gardens at the Regent's Park. The animal, from the nose to the insertion of the tail, measured 1 foot 6 inches, and the tail was 6½ inches in length. The intestines, as in the *Mustelidæ* generally, exhibited no division into small and large, except that the rectum became gradually increased in circumference; their total length was 4 feet 5 inches. The stomach, when moderately inflated, measured 10½ inches in its greatest circumference, 13 along its greater, and 4 inches along its lesser curve. The omentum was thin and irregularly puckered together. At about 5 inches from the anus commenced a group of thickly crowded mucous follicles, occupying a space of 4 inches in length. The anus was furnished with two glands, each of the size of a nutmeg, and containing a fluid of the consistence and colour of liquid honey, and of a most intolerable odour: the orifice or duct of these glands opened just within the verge of the anus. The liver was tripartite, the middle portion being divided into one large and one small lobe; on the under side of the large lobe, in a deep furrow, was situated the gall-bladder, of a moderate size and somewhat elongated form. The biliary secretion entered the duodenum an inch and a half below the pylorus. The pancreas was long, flat, and narrow; beginning in a curved form near the pylorus, and following the course of the duodenum for about 4 inches. The spleen, tongue-shaped, was loosely attached to the stomach and 6 inches in length. The lungs consisted of three right and two left lobes. The heart was of an obtuse figure, measuring an inch and a half in length and an inch in breadth. The primary branches of the aorta were, 1st, a right branch, or arteria innominata, which, running for a quarter of an inch, gave off the two carotids and the right sub-clavian; and, 2nd, a left branch, passing to form the right subclavian. The epiglottis was acuminate, and in close approximation to the tongue, which was tolerably smooth, with a crescent of distinct fossulate papillæ at its base. The os hyoides was united by a succession of four bones on each side to the skull. The kidneys were of an oval form, the right being half its length higher than the left; length of each an inch and a half. The tubuli entered the pelvis of the kidney by a single large conical papilla. Supra-renal glands small. The testes each as large as a small nutmeg; the cremaster muscle, embracing the spermatic cord as it emerges from the ring, very distinct. The penis had been injured in removing the skin of the animal; its length from the pubes was about 3½ inches, and its muscles were very distinct. It contained, as in the dog, a slender bone, 1¾ inch long, rather stout at its commencement, then narrowing as it proceeded till near the apex, when it suddenly bent at an obtuse angle, giving off at this part two small processes. The distance of the prostate from the bladder was an inch and a half.

The habits of the Grison are very sanguinary, and it is a great destroyer of the smaller quadrupeds. It inhabits the greater part of South America, but more particularly Guyana and Paraguay. Dr. Rengger notes both it and *Gulo barbarus* among the plantigrade *Carnivora* of Paraguay, where both species are called Yaguape.

The head is rather large; ears broad and short. Body very much elongated; fur above deep brown, each hair tipped with white, which gives a gray or hoary aspect to the upper parts. A broad white line passing on each side of the front to the shoulders. Nose, throat, underside of body, thighs, and legs, black. Length about 2 feet.

Grison (*Gulo vittatus*).

There is a notice in the 'Zoological Proceedings' for 1830-31 of the exhibition of a living quadruped referrible to *Gulo barbarus*. It was presented to the Society by Edmonstone Hodgkinson, Esq., of Trinidad, who described it as being "playful and gentle, although easily excited and very voracious. It is exceedingly strong, as is indicated by its shape; and it has the same antipathy to water as a cat." Mr. Hodgkinson suspected it to be a native of Peru. He obtained it in Venezuela, where it was presented to him by the president, General Paez. The name he received with it was the Guache; but this appellation, it was observed by Mr. Bennett, was probably erroneously applied to the present animal, belonging rather to the Coati, the orthography of which is variously given as Coati, Couati, Quasje, Quachi, and Guachi. The latter form, it is remarked, occurs in the 'Personal Narrative' of the Baron Von Humboldt, where it evidently refers to a nocturnal species of *Nasua*. The form and general appearance of the animal were remarked to be altogether those of a *Mustela*, to which genus, it was observed, it should probably be referred, together with the typical *Gulo barbarus*. A specimen of the latter was placed upon the table, from which the living animal was shown to differ by the absence of the large yellow spot beneath the neck: a remarkable distinction in this group, but on the occurrence of which, unless confirmed by several specimens, it was considered improper to propose regarding it as a distinct species.

There is a figure and description of the *Galera*, referred to by Linnæus for his *Mustela barbara*, in Browne's 'Jamaica,' p. 485, tab. 49. Browne calls it the *Galera*, or Guinea Fox, and says that it is often brought to Jamaica from the coasts of Guinea (Guyana?), where it is a native, and frequent enough about all the negro settlements. It is, he says, of the size of a small rabbit or cat, and very strong in its fore feet, which are much shorter than the hinder. [MUSTELIDÆ.]

Fossil Gluttons have been detected in the ossiferous caverns; *Gulo spelæus* (Goldfuss), for instance, has been found in those of Gailenreuth, and Sundwick, in Westphalia. Professor Kaup also records another extinct species, *Gulo antediluvianus* (Kaup), from the Epplesheim Sand.

GUM, a vegetable substance frequently met with in the tissues of plants. It exudes from some plants in large quantities, especially the species of *Acacia* [ACACIA], and is collected for commercial and medicinal purposes. [GUM, in ARTS AND SC. DIV.] In a pure state gum is clear, and when dry it is brittle like glass. It is soluble in water and dilute acids, but not so in ether, alcohol, and volatile and fixed oils. The action of alcohol makes it horny, and it is coloured pale yellow by iodine. Its composition is nearly identical with starch and dextrine. Berzelius makes it C_{12} H_{11} O_{11}, and Mülder C_{12} H_{10} O_{10}. It closely resembles dextrine, and through it is allied to starch. The substances called Cerasin, Arabin, and Vegetable Mucilage, seem to be modifications of gum. The principal difference between gum and dextrine consists in the fact that by the action of dilute sulphuric acid, or diastase, the latter is converted into grape-sugar, which is not the case with gum. Gum seems to originate with dextrine. [DEXTRINE; STARCH.]

GUM-RESINS are substances found in plants in which Gum and Resin are mixed together in various proportions. Some families of plants, as the *Umbelliferæ*, are remarkable for exuding these substances. Ammoniacum, Assafœtida, Sagapenum, and Galbanum, are examples. They frequently contain mixed with them a volatile oil which gives to them a medicinal value. [GUM-RESINS, in ARTS AND Sc. DIV.]

GUM-TRAGACANTH. [ASTRAGALUS.]

GUM-TREE. [EUCALYPTUS.]

GUMS. [DENTITION; TEETH.]

GUNNELL. [MURÆNIDÆ.]

GURHOFFIAN. [DOLOMITE.]

GURNARD. [TRIGLA.]

GUTTIFERÆ. [CLUSIACEÆ.]

GUYAQUILLITE, a form of Fossil Resin found in South America. It is soluble in alcohol.

GYALL, the name of the Indian Jungle Bull, *Bos frontalis* of Lambert. [BOVIDÆ.]

GYMNADE'NIA, a genus of Plants belonging to the natural order *Orchidaceæ* and the tribe *Ophrydineæ*. It is distinguished from the genus *Orchis* by the glands of the pollen masses being without a pouch. There are two British species, *G. conopsea* and *G. albida*.

G. conopsea has a 3-lobed lip; the lobes equal, entire, obtuse; the lateral sepals spreading, spur filiform, twice as long as the germen; root-knobs, palmate. The stem is a foot high; leaves linear-lanceolate.

G. Breyerii is a native of South America at the river Magdalena. It has blue flowers; leaves with two or three pairs of unequal leaflets, the extremo ones oblong, elliptical, unequal-sided, middle pair obovate, lower ones roundish; peduncles umbellate.

G. verticale is a native of Mexico and St. Domingo. The flowers are blue with vertical petals. The leaves with three or six pairs, but usually five pairs of oblong coriaceous mucronate leaflets, the outer ones obovate, which are as well as the branches very smooth.

G. sanctum is a tree 20 feet high, a native of South America, particularly in the island of St. Domingo, Mexico, and Brazil.

GYMNARCHUS, a genus of Malacopterygious Apodal Fishes. The body is long and scaly; the gill opening before the pectoral fins; dorsal fin running the whole length of the back; tail ending in a point; head naked and conical; mouth small, with a single row of cutting teeth. *G. Niloticus* is the only species; it inhabits the Nile.

GYMNEMA, a genus of Plants belonging to the natural order *Asclepiadaceæ*. It has a sub-urceolate 5-cleft corolla, the throat usually crowned by five scales or teeth inserted in the recesses between the segments of the corolla. The stamineous corona is wanting. The anthers terminate by a membrane, the pollen masses are erect, fixed by the base. The follicles smooth. Seeds comose, generally marginate. The species are usually twining shrubs, natives of the East Indies, the tropical parts of Australia, and Equinoctial Africa. The leaves are opposite, membranous, and flat. The umbels interpetiolar and cymose. In the greater number of species the stamens are not usually naked, but are furnished with a gland-like body or fleshy tuft at the base of each filament.

G. lactiferum, Cow-Plant, or Milk-Bearing Gymnema, has an erect stem, or rather twining; the leaves are on short petioles, ovate, bluntly acuminated, usually unequal-sided; the umbels many-flowered, shorter than the petioles; the throat of the corolla crowned by five fleshy tubercles; the tube furnished with double pilose lines running from the tubercles. It is a native of Ceylon, where the milk of the plant is sometimes substituted for cow's milk, and the leaves are boiled with food.

G. tingens is a native of Pegu. It has a twining glabrous stem, cordate leaves, acuminated to oval; the umbels or corymbs often twiu, at first shorter than the petioles, and at length spirally elongated; the glands of the filaments one-half shorter than the stamens; follicles cylindrical, spoon-shaped; stigma simple, oval, mutic, crowning the tube of the corolla, and therefore exceeding the stamens. The flowers are largish, numerous, and of a pale-yellow colour. The calyx 5-cleft to the base. From the leaves of this plant a green dye is prepared by the Burmese. Seventeen species of this genus are enumerated, none of them of any particular interest.

(Lindley, *Vegetable Kingdom;* Don, *Dichlamydeous Plants.*)

GYMNETRUS, a genus of Fishes belonging to the group of Riband-Shaped *Acanthopterygii*. It has the following characters:—Body elongated, compressed; a single dorsal fin extending the whole length of the back; ventrals consisting each of a single ray, only sometimes very long and dilated at the end; no anal fin; teeth pointed, small. The species of this genus have very rarely been obtained entire. They have generally been taken dead, and consequently have been crushed and mutilated. Of the species of this genus, Mr. Yarrell says, "three probably belong to the Mediterranean, two to the seas of the North of Europe, and two to India. One northern species, besides one of those apparently belonging to India, has been taken on the shores of this country. That of the north has occurred more than once in Scotland; that of India once on the coast of Cornwall."

G. Hawkenii (Bloch), Hawken's Gymnetrus, the Oared Gymnetrus, the Ceil Conin of Cornwall. This species has been taken in Cornwall. The following description has been drawn up by Mr. Couch from a drawing and notes of a specimen taken in a net at Mount's Bay in 1791:—"The length without the extremity of the tail, which was wanting, was 8½ feet; the depth 10¼ inches; thickness 2¾ inches; weight 40 lbs. In the drawing the head ends in a short and elevated front; eye large; pectoral fin round; no anal fin; the dorsal fin reaches from above the eye to the tail. The ventrals are formed of four long red processes, proceeding from the thorax, and ending in a fan-shaped appendage, of which the base is purple, the expansion crimson. The back and belly are dusky-green; the sides whitish; the whole varied with clouds and spots of a darker green; the fins crimson." A very fine specimen of this fish caught off the coast of Northumberland, was exhibited in London at the time the discovery of the Great Sea-Serpent was announced, and was supposed to explain the nature of this discovery.

The *Gymnetrus arcticus* of Cuvier, the Vaagnaer, or Deal-Fish, has been referred to the genus *Trachypterus*. [TRACHYPTERUS.]

GYMNOCEPHALUS. [CORACINA.]

GYMNO'CLADUS (from γύμνος, naked, and κλάδος, a branch), a genus of Plants belonging to the natural order *Leguminosæ*. It has diœcious flowers; the calyx tubular, 5-cleft; the petals five, equal, oblong, exserted from the tube; the stamens ten, inclosed; the legume oblong, thick, filled with pulp inside. There is but one species, *G. Canadensis*, the Kentucky Coffee-Tree. It is an upright deciduous tree, with compound alternate, stipulate, bipinnate leaves, and white flowers in terminal racemes. The branches of this tree are without any appearance of buds, which, during the winter, gives it the aspect of a dead tree, and hence the Canadian name 'chicot,' or stump-tree. The wood is hard, compact, and of a fine rose colour. In America it is used in cabinet-making and carpentry. It has the property of rapidly converting its sap-wood into heart-wood, so that the smallest trees may be converted to useful purposes. The seeds were at one time roasted and ground as a substitute for coffee in Kentucky and Tennessee; but they are not often used in this way at the present day. The pods, preserved in the same way as the tamarind, are said to be wholesome and aperient. This tree grows well in Great Britain, but does not ripen its seeds. It is best propagated by imported seeds, but it will also grow freely from cuttings of the roots. It requires a rich, deep, free soil. (Loudon, *Encyclopædia of Trees and Shrubs.*)

GYMNODACTYLUS. [GECKOTIDÆ.]

GYMNODERUS. [CORACINA.]

GYMNOGASTER. [TRACHYPTERUS.]

GYMNOGENS, or GYMNOSPERMS, one of the divisions under which the vegetable kingdom is now classified. The name is derived from the seeds being naked, that is to say, unprotected by a pericarpal covering, and fertilised by the pollen coming in direct contact with the ovule, not by the intervention of the apparatus called stigma and style. In this respect Gymnosperms are analogous to those reptiles which, in the animal kingdom, have eggs that are impregnated by the male after they have been deposited by the mother.

The plants comprehended in this class have nearly an equal relation to flowering and flowerless plants. With the former they agree in habits, in the presence of sexes, and in their vascular tissue being complete; with Ferns and Club-Mosses, among the latter, some also accord in habit, in the peculiar gyrate vernation of the leaves of some Cycads, in their spiral vessels being imperfectly formed, and in the sexes being less complete than in other flowering plants; the females wanting a pericarpal covering, and receiving fertilisation directly through the foramen of the ovule, without the intervention of style or stigma, and the males sometimes consisting of leaves imperfectly contracted into an anther bearing a number of pollen-cases upon their surface. So great is the resemblance between Club-Mosses and certain Conifers, that there is no obvious external character except size by which they can be distinguished. Gymnogens are known from most other *Vasculares* by the vessels of their wood having large apparent perforations or discs. [CONIFERÆ.] It is not however on this account to be understood that they differ in growth from other Exogens; on the contrary they are essentially the same, deviating in no respect from the plan upon which Exogenous Plants increase, but having a kind of tissue peculiar to themselves. At this point of the vegetable kingdom there is a plain transition from the highest form of organisation to the lowest. Gymnogens are essentially Exogens in all that appertains to the organs of vegetation; they have concentric zones in their wood, a vascular system in which spiral vessels are found, and a central pith, but they are analogous to reptiles in the animal kingdom. The two most remarkable of the orders are Conifers and Cycads. Of these the former is connected with Club-Mosses among Acrogens by means of the extinct genus *Lepidodendron*, and their branches are sometimes so similar to those of certain Lycopods themselves as to leave no doubt of their relation. Compare, for instance, *Lycopodium phlegmaria*, and *Cunninghamia sinensis*. Some Cycads have the gyrate vernation of the leaves of true Ferns, along with the inflorescence of Conifers; and their mode of forming their trunk, although essentially the same as that of Exogens, yet resembles the growth of Acrogens in lengthening by a terminal bud only. While however the class of Gymnogens is thus distinctly marked by the most important physiological peculiarities, it approaches the highest forms of vegetation by that portion of it which bears the name of Joint-Firs (*Gnetaceæ*)—plants with all the structure of their class, but with the manner of growth of Chloranths (*Chloranthaceæ*) and Beefwoods (*Casuarinaceæ*). (Lindley 'Vegetable Kingdom.')

The following figure of *Juniperus Oxycedrus* will show the peculiarities of this class:—*Fig.* 1 is a male catkin; *fig.* 2, a scale from it having anthers on its under side; *fig.* 3, a female cluster of flowers seated at the end of a scaly peduncle; *fig.* 4, a longitudinal section of the same, showing the naked ovules seated within the scales; *fig.* 5 is a ripe fruit, composed of three scales, become fleshy and consolidated, and burying the seeds within their centre; *fig.* 6 is the same fruit divided transversely, to show how the seeds are placed within the ripe fruit; *fig.* 7 is a seed; *fig.* 8, a longitudinal, and *fig.* 9, a transverse section of the same. [CYCADACEÆ; TAXACEÆ; GNETACEÆ; CONIFERÆ.]

Juniperus Oxycedrus.

GYMNOPS, a genus of Birds established by Cuvier and described by him as having a bill strong as that of the Orioles; the nostrils round, without scales or any membranous entourage, and a great part of the head denuded of feathers. He refers to *Gracula calva*, Gmel., *Mino Dumontii*, Less., and *Gracula cyanotis*, Lath. (*Merops cyanotis*, Sh.), as examples.

GYMNOSPERMS. [GYMNOGENS.]

GYMNO'TUS, a genus of Fishes belonging to the section *Apodes*. It has the following generic characters:—Gills partially closed by a membrane, and opening before the pectorals; the vent placed very far forwards; body without any perceptible scales, and without dorsal fin; anal fin extending the greater part of the length of the body.

G. electricus (Linn.), from the resemblance it bears to an eel, and the electric power which it possesses, has been called the Electric-Eel. It is about 5 or 6 feet in length; the head is rather broad and depressed; the muzzle is obtuse: the body, compared with that of the common eel, is stouter and shorter in proportion; the anterior part is nearly cylindrical, but towards and at the tail it is compressed; the pectoral fins are small and rounded; the anal fin commences at a short distance behind the line of the pectoral fins, and extends uninterruptedly to the tail; there is no caudal fin. Its colour is brownish-black.

The Electric-Eel is said to communicate shocks so violent that men and even horses are overpowered by them. This power is dependent on the will of the animal, but decreases in strength if frequently repeated, unless at considerable intervals. The organs by which this shock is produced are minutely described by Hunter in the 65th volume of the 'Philosophical Transactions.' All the species of *Gymnotus* inhabit the rivers of South America. [ELECTRICITY OF ORGANIC BEINGS.]

The genus *Carapus* of Cuvier contains such species of *Gymnotus* of the older authors as have the tail lengthened and tapering, and the body compressed and furnished with scales. They also inhabit South America.

GYMNU'RA, a genus of Animals belonging to the family *Talpidæ* and the order *Feræ* of Dr. Gray. The only species of this genus was first described by Sir Stamford Raffles. It was afterwards more accurately examined by Dr. Horsfield and Mr. Vigors, who figured it in the 'Zoological Journal.'

Sir Stamford Raffles referred the species to the Linnæan genus *Viverra*, and recorded it as *Viverra Gymnura*. But although he did not nominally raise the animal to the importance of a genus, he gave so clear and accurate a description of its generic characters that Dr. Horsfield and Mr. Vigors do not hesitate to attribute the first indication of the group to him; and they proceed to give the generic character of *Gymnura*:—

$$\text{Incisors, } \frac{2}{6}\text{; canines (}\textit{Laniarii}\text{), } \frac{2-2}{1-1}\text{; molars, } \frac{8-8}{7-7} = 44.$$

Incisors, 2 above, remote, very large, subcylindrical, rounded at the apex; 6 below, the four intermediate approximate, rather short, inclined (proclives) compressed, the anterior surface (pagina) convex, the interior flat, edge rounded (scalpro rotundato), the two lateral abbreviated, acute. Canines (Laniarii), 2 on each side above, remote from the incisors and shorter than them, the anterior ones the longest; 1 on each side below, very large, conical, subarcuate, looking inwards. Molars, 8 on each side above, remote from the canines, the three anterior unicuspid, the first elongated and sectorial; the second and third abbreviated; the fourth with an elongated conical point and a posterior and exterior abbreviated lobe or step (gradu) at the base; the fifth with the exterior cusp very long, and the interior one abbreviated; the sixth and seventh very large, multicuspid, the cusps sub-abbreviated and rounded; the eighth smaller and more fashioned for triturating (subtritorius), the cusps rather obtuse; 7 below, the three anterior unicuspid, compressed; the first and second shorter; the third sub-elongated; the fourth with an elongated cusp, an anterior lobe, and another posterior lobe (gradu) abbreviated; the fifth, sixth, and seventh very large, multicuspid, the cusps rather elevated and acute.

Head elongated, acuminated, narrowed, compressed on the sides, flattish above. Muzzle (rostrum) obtuse, elongated, stretched forward (protensum), much surpassing the lower jaw in length. Nostrils lateral, prominent, with the margins convoluted. Tongue rather smooth, large. Auricles rounded, somewhat prominent, naked. Eyes small. Whiskers (vibrissæ) elongated.

Body rather robust, ground of the fur (cordaris) soft, but with distant erect sub-elongated harsh hairs. Tail rather long, smooth, attenuated, naked, scaly, with a few scattered hairs in youth.

Feet moderate, plantigrade, pentadactyle, the fore feet with a rather short thumb, the three intermediate fingers rather long and sub-equal; the hind feet with a very short great toe, the three intermediate toes very much elongated, and the external toe moderate. Claws moderate, narrow, curved, compressed, very acute, retractile.

Such is the character given by Dr. Horsfield and Mr. Vigors to *Gymnura*, and they state their opinion that the nearest affinity to this genus appears to be met with in *Tupaia* (Raffles). From that group however they say that *Gymnura* is sufficiently distinguished, besides the difference in the system of dentition, by the elongation of the rostrum, the comparative robustness of the body, the setose character of the hairs, which are sparingly mingled with the soft fur, the small retractile claws, and the nakedness of the tail. In general appearance they hold that the group bears a strong resemblance to some species of the Marsupial genus *Didelphis*.

G. Rafflesii, the Bulau or Tikus, has the body, feet, stripe above the eyes, scattered occipital hairs, and the basal half of the tail, black; the head, the neck, the scattered hairs of the back, and the other half of the tail, white. (Horsfield and Vigors.)

An adult specimen examined by Horsfield and Vigors measured—

	Ft.	In.	Lines.
Length of the body and head from the extremity of the proboscis to the root of the tail	1	2	3
Length of the tail	0	10	6
Length of the head	0	4	3
Length of the proboscis	0	0	8
Breadth of the head across the ears	0	1	6
Distance between the eyes	0	1	0
Height at the shoulder	0	5	0
Height at the rump	0	4	6
Length of the anterior tarsus and toes	0	1	9
Length of the posterior ditto	0	2	0

M. Lesson ('Manual,' 1827), places the 94th genus, *Gymnura*, between the dogs with hyæna's feet (*Canis pictus*, Desm.; *Hyæna picta*, Temm.), and *Viverra*, Linn., the first sub-genus of which he makes to consist of the true Civets. He says of *Gymnura*, "We form this genus in conformity with the opinion (d'après l'avis) of M. Desmarest, in order to place in it an animal closely approximating to the Civets, and perhaps approximating still nearer to the *Paradoxuri*, which are plantigrade. We place it provisionally among the digitigrades. It has a pointed muzzle, a soft tongue, rounded ears, erect and naked, compressed claws, curved and sharp, a naked tail, and the following dental formula:—

"Incisives, $\frac{6}{6}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{6-6}{6-6}=40$.

"In the upper jaw the two middle incisives are the largest, and separated (écartées) one from the other; the two lateral ones are very small; the canines are moderate. The first molar has two points, the second one only; the fourth and fifth have four tubercles, the sixth has only three.

"In the lower jaw the canines are long.

"Species, *Gymnura Rafflesii*, *Viverra Gymnura*, Raffles. This species, from the East Indies, has the muzzle, which exceeds the lower jaw by an inch, pointed; the eyes are small, the moustaches long; the tail, which is naked, like that of a rat, is only 10 inches long, and the head and body measure 1 foot. The fur consists of two sorts of hair, a short under fur (bourre) very thick and soft, and a long harsh hair; the body, legs, and first half of the tail are black; the head, the neck, and the shoulders are white; a black band passes over the eyes. Habits unknown."

Gymnura Rafflesii. Horsfield and Vigors.

M. Lesson does not state from what specimen he has taken his descriptions, which vary from those of Dr. Horsfield and Mr. Vigors, in some instances essentially; but the latter state the ample materials from which they defined their characters.

Cuvier says, "The genus *Gymnura* of Messrs. Vigors and Horsfield 'Zool. Journal,' iii. pl. 8) appears to approach *Cladobates* in its teeth, and the shrews (musaraignes) in its pointed muzzle and scaly tail. It has five unguiculated toes on all its feet, and rather stiff bristles (soies assez rudes) projecting forth from the woolly hair. It cannot be well classed till its anatomy is known."

The term *Gymnura* has been applied to designate a genus of Sea-Ducks [DUCKS]; and Spix uses the word *Gymnuri* as the name of a family of South American Monkeys.

GYNA'NDRIA, one of the classes in the artificial system of botany invented by Linnæus, the character of which is to have the stamens and pistil consolidated into a single body. The principal part of the class consists of Orchidaceous Plants, forming in it the order *Monandria*.

GYNOCARDIA. [FLACOURTIACEÆ.]

GYPAËTOS, Storr's generic name for the Lämmergeyer, or Bearded Griffin (*Gypaëtos barbatus*), a bird of prey which may be considered as intermediate between the Eagles and the Vultures. [VULTURIDÆ.]

GYPOGE'RANUS (Illiger), a genus of Birds embracing the well-known Secretary Bird. Mr. Bennett, in the 'Tower Menagerie,' remarks that the singular conformation of this bird, so different in many respects from that of the order to which both in its leading characters and in its habits it obviously belongs, rendered it for a long time the torment of ornithologists, who puzzled themselves in vain to assign it a definite place in the system, and could not agree even with regard to the grand division of the class to which it ought to be referred. "Thus" continues the author, "M. Temminck was at one time inclined to refer it to the Gallinaceous order; and M. Vieillot, after repeatedly changing his mind upon the subject, at last arranged it among the Waders, with which it has absolutely nothing in common except the length of its legs. It appears however to be now almost universally admitted that its closest affinity is with the Vultures, with which it agrees in the most essential particulars of its organisation, and from which it differs chiefly in certain external characters alone, which unquestionably give to it an aspect exceedingly distinct, but are not of themselves of sufficient importance to authorise its removal to a distant part of the classification. It constitutes in fact one of those mixed and aberrant forms by means of which the arbitrary divisions of natural objects established by man are so frequently assimilated to each other in the most beautiful, and occasionally in the most unexpected manner." Mr. Swainson, in the first volume of his 'Classification of Birds,' places the "Secretary Vulture of Africa" among the *Vulturidæ*; but in the second volume of the same work (1837), he makes it a genus of the *Aquilinæ*, a subfamily of the *Falconidæ*.

Dr. Sparrman first saw this bird (a drawing of which, given by M. Vosmaer under the denomination of *Sagittarius*, he alludes to) in the neighbourhood of the warm baths of Hottentot Holland. "It is not," he says, "a very shy bird, but when scared begins at first to endeavour to save itself by alternately hopping and scudding along very swiftly, and afterwards does it more effectually by flight. In external appearance, in some respects it resembles the eagle, and in others the crane, two birds certainly very unlike each other; though in my opinion it ought to be referred to neither of these genera. The Hottentots give it a name most suitable to its nature, namely, as translated into Dutch, Slangen-Vreeter (or Serpent-Eater); and in fact it is for the purpose of confining within due bounds the race of serpents, which in Africa is very extensive, that nature has principally destined this bird. It is larger than our crane, with legs 2½ feet long, and the body in proportion less than the crane's. Its beak, claws, stout thighs covered with feathers, and short neck, are like those of the eagle and hawk kind." Then follows a particular description of the bird, after which the Doctor continues thus: "This bird has a peculiar method of seizing upon serpents. When it approaches them it always takes care to hold the point of one of its wings before it, in order to parry off their venomous bites; sometimes it finds an opportunity of spurning and treading upon its antagonist, or else of taking it up on its pinions and throwing it into the air; when by this method of proceeding it has at length wearied out its adversary, and rendered it almost senseless, it then kills it and swallows it without danger. Though I have very frequently seen the Secretary Bird, both in its wild and tame state, yet I have never had an opportunity of seeing this method it has of catching serpents; however I can by no means harbour any doubt concerning it, after having had it confirmed to me by so many Hottentots as well as Christians; and since this bird has been observed at the menagerie at the Hague to amuse and exercise itself in the same manner with a straw. If, finally, this serpent-eater is to be referred to the *Accipitres*, or the Hawk kind, the name of *Falco Serpentarius* appears to be the most proper to distinguish it by in the 'Systema Naturæ.' It has even been remarked that these birds, when tame, will not disdain now and then to put up with a nice chicken."

Sparrman, it is true, did not himself see the scene which he describes; but that his account is correct in the main will not be doubted when we present the reader with a translation of the testimony of an eye-witness—of one at whose relations the devoted admirers of Buffon were too apt to smile incredulously, but whose accuracy is now generally allowed to be unimpeachable. We give it entire, because even in those parts which are not directly illustrative of the habits of the bird, the difference between the actual observer, the field zoologist, who had studied nature in her own wilderness, and the cabinet theorist, who had only viewed her through the false medium of his own brilliant but delusive imagination, is strikingly displayed. Le Vaillant, in one of his journeys in the Namaqua country, arrived at a spring at the very moment when a Secretary was drinking there: he killed it at the first shot, and gave to the well the name of the Secretary's Fountain. His narrative then proceeds as follows:—

"The Dutch have named this bird the Secretary on account of the tuft of plumes which it carries at the back of the head; for, in Holland, clerks (gens de cabinet), when they are interrupted in their writing, stick the pen among their hair behind the right ear, so as to imitate in some degree its crest. Buffon, speaking of it, says that it has only been known at the Cape recently; and the proof which he adduces is, that Kolbe and other succeeding writers say nothing of it. This is advancing a groundless assertion (un fait faux), and endeavouring to prove it by another as true as the first. The Secretary is known in the colonies both under the name of Secretaris and that of Slang-Vreeter. It is under this last denomination that Kolbe speaks of it; and he certainly knew it, at least from the relation of others, because he exactly enumerates all the kinds of food which it habitually takes. It is true that, in his description, he translates the Dutch word Slang-Vreeter by the French word Pélican, and that consequently he makes a single species out of two very different ones. But Kolbe was no naturalist, and his work contains so many other errors that it would be astonishing not to find this. I have been more surprised, I confess, to see that our modern naturalists, even those who have spoken of the Secretary in the greatest detail, make no mention of three bony and blunt protuberances which it has at the bend and last joint of the wings, but infinitely less apparent than in the Jacana or in the Kamicki. This omission has appeared strange to me, in Buffon particularly, who has not described it from the relation of others, but from an individual which he had before his eyes, and which I believe was in the cabinet of Mauduit. It is nevertheless an essential omission, because it deprives the Secretary of one of its principal distinctive characters, and because the protuberances of which I speak form one of the arms of the bird, as I shall presently show. I shall permit myself moreover to make a remark on what Buffon has written. According to him the Secretary differs from other birds in its timid nature; and its timidity is even such, says he, that when attacked by its enemies it has no other resource for its preservation excepting flight. This is an error. Those who have been able to study this bird know that, living especially on reptiles, it is continually at war with them; that it seeks them everywhere, and attacks them courageously. For this assertion I cite the testimony of Querhoeut, and bring forward in proof of it the fact which I have witnessed.

"In descending from a mountain into a very deep bog (fondrière) I perceived, nearly perpendicularly below me, a bird which raised and lowered itself very rapidly, with very extraordinary motions. Although I well knew the Secretary, and had killed many of these birds at Natal, it was impossible for me to recognise it in the vertical situation in which I found myself, and I only suspected that it was one from its bearing. Having found means, by favour of some rocks, to approach sufficiently near, noiselessly and without being discovered, I found that this bird was a Secretary combating a serpent. The fight was very sharp on both sides, and the skill (la ruse) equal on the part of each of the combatants. But the serpent, which perceived the inequality of its strength, employed that adroit cunning which is attributed to it, in order to save itself by flight and regain its hole; while the bird, divining its intention, stopped it at once, and throwing itself before the serpent by one spring cut off its retreat. Wherever the reptile essayed to escape there it always found its enemy. Then, uniting skill with courage, it erected itself fiercely to intimidate the bird, and presented, with a frightful hiss, a menacing gape, inflamed eyes, and a head swollen with rage and poison.

"Sometimes this offensive resistance suspended hostilities for an instant; but the bird soon returned to the charge; and covering its body with one of its wings as with a shield, struck its enemy with the other, with the bony protuberances of which I have already spoken, and which, like small clubs, overpowered it the more surely, inasmuch as it presented itself to the blows. In effect, I saw it reel and fall extended: then the conqueror threw himself upon it to finish his work; and with one blow of the bill split its skull.

"At this moment, having no further observations to make, I killed it. I found in its crop (for it has one, which nobody has stated), on dissecting it, eleven rather large lizards, three serpents as long as one's arm, eleven small tortoises very entire, many of which were about two inches in diameter, and, finally, a quantity of locusts (sauterelles) and insects, the greater part of which were sufficiently whole to deserve being collected and to be added to my specimens. The lizards, the serpents, and the tortoises had all received the stroke of the bill on the head. I observed besides, that independently of this mass of aliments the craw (poche) of the animal contained a species of pellet, as large as a goose's egg, and formed of the vertebræ of serpents and lizards which the bird had devoured previously, scales of small tortoises, and the wings, feet, and corselets of different *Scarabæi*. Doubtless when the undigested mass is become too large, the Secretary, like other birds of prey, vomits it and gets rid of it. It results from the superabundant quantity of nourishment which this specimen had secured, that in attacking the serpent of the bog, it was not hunger which had stimulated it to the combat, but the hatred and antipathy which it bears to these reptiles. Such an aversion as this is of an inappreciable advantage in a country where the temperature wonderfully favours the multiplication of an infinity of noxious and venomous animals. In this point of view the Secretary is one of nature's real benefactions; and indeed its utility and the services rendered by it are so well recognised at the Cape and in its neighbourhood, that the colonists and Hottentots respect it and do not kill it; herein imitating the Dutch, who do not kill the stork, and the Egyptians, who never injure the ibis.

"The Secretary is easily tamed, and when domesticated, every kind of nourishment, cooked or raw, agrees with it equally. If care be taken to feed it well, it not only lives amicably and peaceably with the poultry, but when it sees any dispute going on it runs to separate the combatants and to restore order. It is true that if it be permitted to suffer from hunger, it provides for itself, and then falls without scruple upon the ducklings and chicks. But this abuse of confidence, if abuse of confidence it can be called, is nothing but the imperious effect of want, and the pure and simple exercise of that necessity which devotes the half of all that breathes to the appetite of the other half. I have seen tame Secretaries at many houses. The eggs ordinarily amount to from two to three, nearly as large as those of a goose, and white like those of a hen. The young remain a long time before they quit the nest, because their legs being long and slender, they sustain themselves with difficulty. They may be observed, even up to the age of four months, unable to progress except by leaning on their heels; which gives them a strikingly clumsy and ungraceful air. Nevertheless, as their toes are not so long nor their claws so curved as the other birds of prey, they walk with much more facility than those. So that when they have attained the age of seven months they may be seen to develop easy and graceful movements which suit well with their noble bearing. Buffon, quoting the Dutch naturalist, says, that when the latter was drawing his Secretary, the curious bird came to look upon the paper with outstretched neck and upstanding crest, as if admiring its likeness, &c. Certainly the Secretary is sufficiently interesting on account of its instinct and natural qualities, without requiring to be gifted by its historian with an admiring taste for drawing and a sort of pride at seeing itself represented. If Vosmaer's Secretary approached him, stretching out its neck and raising its crest, it was, in my opinion, neither from curiosity nor delight, but only from a sort of habit which is common to many other birds. We know that the majority of them, when they are familiar and domesticated, love to have their polls scratched; that this titillation seems to give them pleasure; and that they present themselves to the first comer and stretch out their neck to beg for this service. We see this in Europe with reference to the peacock and the parrakeet.

"The Secretary is found on all the arid plains in the neighbourhood of the Cape. I have found it in the east, on the whole line of coast, in Caffraria, and even far inland. But in the west, although this part of Africa presents deserts still more arid than those of the east, and although it consequently offers to the bird the different sorts of food which are congenial to it, I have never met with one beyond the country of the Great Namaquas. I will add only one word on this interesting animal: it has not the bill of a gallinaceous bird, as Vosmaer says it has; but a true bill of a bird of prey. Nor has it, as Buffon declares, the leg bare of feathers like the shore birds (oiseaux de rivage). For the rest, I refer to my 'Ornithology,' where I shall enter into greater details on the subject of the Secretary." (Le Vaillant, 'Second Voyage dans l'Intérieur de l'Afrique,' &c., tom. ii.)

M. Lesson quotes the account of Mr. Smith, who relates that one day he saw a Secretary take two or three turns on the wing at a little distance from the place where he was. The bird soon settled, and Mr. Smith saw that it was attentively examining an object near the spot where it had descended. After approaching it with great precaution the Secretary extended one of its wings, which the bird continually agitated. Mr. Smith then discovered a large serpent raising its head, and appearing to wait the approach of the bird to dart upon it; but a quick blow of the wing soon laid it prostrate. The bird appeared to wait for the serpent's raising itself, in order to repeat the blow; but this the serpent, it seems, did not attempt, and the Secretary walking towards it, seized it with the feet and bill, and rose perpendicularly into the air, whence the bird let the serpent fall on the ground, so that it might be securely destroyed.

Gmelin placed the Secretary at the head of the genus *Falco*, immediately after the genus *Vultur*.

Duméril, Temminck, De Blainville, Latreille, Vigors, and Illiger place it in the order of Rapacious Birds.

Baron Cuvier arranges the form among the Falcons.

M. Vieillot places it among the *Grallatores*.

M. Lesson makes the third and last family of his Diurnal Birds of Prey consist of *Gypogeranus*; the first consists of the *Vulturidæ*, and the second of the *Falconidæ*.

Mr. Swainson makes the Secretary the third and last type of the family *Vulturidæ*.

Mr. Ogilby, at a meeting of the Zoological Society of London (July, 1835), observed that a Secretary (*Gypogeranus*) in Mr. Rendall's collection offered some peculiarities when compared with the common Cape animal, which at first induced Mr. Ogilby to believe that it might be a distinct species, and in this opinion he was in some degree confirmed by Mr. Gould; but he stated that a more attentive comparison of specimens from both localities (Mr. Rendall's having been sent from the Gambia), had considerably shaken his original opinion. Mr. Ogilby remarked however that still greater differences are indicated by Sonnerat in his figure and description of the Secretary of the Philippine Islands, and which, as far as the former was aware, had not been noticed by more recent naturalists. Whether or not the Secretaries of these three localities, the Cape of Good Hope, the Gambia, and the Philippines, may eventually turn out to be really distinct, or only varieties of the same species, must, he further remarked, be left for future observation; but, as it would be at least useful to direct the attention of travellers, collectors, and zoologists to the subject, he stated the principal marks which appeared to distinguish each, giving them provisionally specific names derived from the localities which they respectively inhabit as follows:—

1. *G. Capensis*, with the plume of long cervical feathers commencing upon the occiput, spreading irregularly over the upper part of the neck, narrow throughout the greater part of their length, as if the beard had been cut on each side close into the shaft of the quill, and spreading only at the point. Inhabits the Cape of Good Hope.

2. *G. Gambiensis*, with the cervical crest commencing some distance below the occiput, arranged in two regular series, one on each side of the neck, with the intermediate space clear, and composed of long spatule-shaped feathers, much broader throughout than in the last species, though similarly decreasing in width towards the root. In both these species the two middle feathers of the tail are considerably longer than the others. Inhabits Senegambia.

3. *G. Philippensis*, with the cervical crest spread irregularly from the occiput to the bottom of the neck, the longest feathers being those situated the lowest, which is just the reverse of what is observed in *G. Gambiensis*, and with the two exterior tail-feathers the longest, so that the tail appears forked. This is apparent not only in Sonnerat's

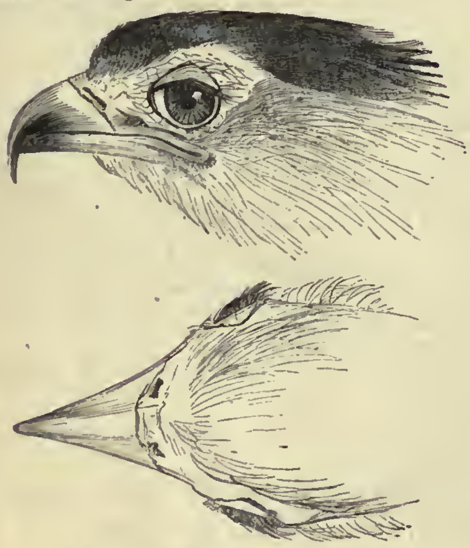
figure, but is expressly mentioned in his detailed description, and, if confirmed by future observation, is clearly indicative of a specific distinction. Inhabits the Philippine Islands. Described and figured in Sonnerat's 'Voyage à la Nouvelle Guinée,' p. 87, t. 50.

The colours of the three species or varieties here indicated do not, says Mr. Ogilby in conclusion, seem to be materially different in other respects.

Sonnerat commences his description by saying that the Secretary is not only found in the Philippines, but that it also inhabits Africa, and is known at the Cape of Good Hope. He speaks of the bird as being of the size of a turkey (Coq d'Inde), and as having the bill and feet of the Gallinaceous Birds, but notices that the legs are denuded of feathers to just above the knee. Of the accuracy of the description, as far as the alleged gallinaceous bill and feet are concerned, the student will have an opportunity of judging from the African specimens in our museums, and the living bird in the menagerie of the Zoological Society of London at the Regent's Park. But travellers and collectors will do well to bear Mr. Ogilby's provisional distinctions in mind; for the form, as we have seen, is so interesting to zoologists, that every modification of it must be considered of value. Speaking of the manners of the bird described in the 'Voyage à la Nouvelle Guinée,' Sonnerat says that it is sociable, and lives in a state of domesticity; that it hunts rats, and might, in this point of view, become useful in the colonies, where probably it would not be difficult to multiply it. Although he describes the bill and feet of the Secretary as being those of the Gallinaceous Birds, he states that it feeds on flesh, and ought consequently to be placed in the ranks of the Birds of Prey, among which, he adds, it forms an entirely insulated genus.

Gypogeranus is, as M. Lesson has stated, and as appears by its skeleton, a true Bird of Prey, with long legs: the number of the cervical vertebræ, an important feature according to the views of some zoologists, is thirteen, the atlas included. It is difficult to draw the line between the dorsal and cervical vertebræ in birds; but in two skeletons of the Secretary in the museum of the Royal College of Surgeons (No. 1207 and No. 1207*a*), there are nineteen vertebræ, counting from the ilium to the cranium, and of these thirteen may be considered cervical, because in them the costal processes are anchylosed.

The following are the generic characters of this bird:—Bill rather slender, shorter than the head, strong, very much hooked, curved nearly from its origin, and furnished with a cere at its base, rather vaulted, compressed at the point; nostrils placed at a small distance from the base, lateral, pierced in the cere, diagonal, oblong, open. Feet very long, slender, the tibia feathered, but not quite to what is called (improperly) the knee behind, whilst the feathers come a very little below the joint before; tarsus long, more slender below than in its upper part; toes short, warty below, the anterior toes united at the base by a membrane; hind toe articulated upon the tarsus. Wings long, armed with obtuse spurs; the first five quills the longest and nearly equal.



Bill of Secretary (*Gypogeranus Serpentarius*).

M. Lesson says that a single species (African) (*Falco Serpentarius*, Gmel.) composes this genus, and that attempts have been made to introduce the breed into the French sugar islands (Martinique, &c.), in the hope that it might diminish the race of the formidable *Trigonocephalus*, the Yellow Serpent of the Antilles (*Trigonocephalus lanceolatus*, Opp.), the most dangerous reptile of those parts, six or seven feet in length, and rivalling the Rattlesnake in the intensity of its poison.

Size, about three feet in length. Eye full, surrounded by a naked skin, with a series of hairs beneath the overshadowing feathers in the form of an eyebrow; eyelashes long and strong. Plumage, when perfect, for the most part bluish-gray, with a reddish-brown tinge on the wings; greater quills black. Throat and breast nearly white; rest of the under surface black, reddish, and white intermingled, the plumage of the legs bright black, with a slight intermixture of brownish rays. Occipital crest, which can be raised or depressed at pleasure, consisting of feathers without barbs at the base, but spreading out as they advance, and coloured of a mixed black and gray. Two middle tail-feathers longest.

Secretary (*Gypogeranus Serpentarius*).

The Secretaries live in pairs, and do not collect in flocks; they build on high trees; but if these are not to be had, in very close thickets. They run with considerable swiftness, and are approached with difficulty by the sportsman.

At first sight this bird resembles the Çariama (*Palamadea cristata*), but this is only an external resemblance, as their internal structure and habits differ much. [ÇARIAMA.] Both these birds are now to be seen alive in the Gardens of the Zoological Society, Regent's Park.

GYPS. [VULTURIDÆ.]

GYPSOCALLIS (Don), a genus of Plants belonging to the natural order *Ericaceæ*. It is one of the names proposed by David Don for a section of the genus *Erica*. These genera have not been generally adopted. (Don, *Dichlamydeous Plants*.)

GYPSUM, a native Sulphate of Lime. It is called also in various forms *Selenite*, *Plaster of Paris*, and *Alabaster*. It is monoclinate, and crystallises usually in right rhomboidal prisms with beveled sides. It has a hardness of 1·5 to 2·0. Its specific gravity is 2·31 to 2·33. The crystals are remarkably foliate in one direction and cleaving easily, affording laminæ that are flexible but not elastic. It occurs also in laminated masses often of large size. It is found also in fibrous masses with a satin lustre, in stellated or radiating forms consisting of narrow laminæ, and also granular and compact. When pure and crystallised it is quite clear and pellucid like glass, and has a pearly lustre. It is sometimes gray, yellow, reddish, brownish, and even black and opaque. It is composed of one atom of sulphuric acid and one atom of lime. In its crystallised form it is combined with water, thus:—

Sulphuric Acid	. 46·3	
Lime	. 32·9	
Water	. 20·8	
		100·0

Its formula is $SO_3 + CaO$. Before the blow-pipe it becomes instantly white and opaque, and exfoliates, and then falls to powder or crumbles easily in the fingers. It fuses with difficulty, and presents no action with acids.

The following are its principal varieties:—

Selenite, transparent and foliated.
Radiated Gypsum, having a radiated structure.
Satin Spar, or *Fibrous Gypsum*, with white and delicate fibres.
Alabaster, or *Snowy Gypsum*, white or light, with a very fine grain.
Plaster of Paris, when burnt and ground.

Gypsum in all its varieties, is readily distinguished from all other minerals, by its softness, by its becoming an opaque powder without fusing before the blow-pipe, and the absence of all effervescence or gelatinising with acids.

Sulphate of Lime is a frequent constituent of the strata of the earth. It is found in layers in the Magnesian Limestone, is abundant in the London Clay, and is a prominent constituent of many tertiary deposits, as that of Paris. It is constantly present in the river and spring waters of Great Britain. It is found in the Thames, in the springs of Bath and Bristol, and in many others. Gypsum is worked at Paris, ground and burned, hence called Plaster of Paris. When water is added to this powder it becomes a paste, which subsequently hardens; hence its varied uses in the arts, whenever the object is to procure casts or models in relief. Alabaster comes mostly from Castelino in Italy. It is cut into vases, statues, and ornaments of various kinds. Alabaster is also found in the Mammoth cave in Kentucky, United States. It occurs in singularly beautiful imitation of flowers, leaves, shrubberies, and vines. Massive Gypsum occurs abundantly in New York, accompanying the rocks which afford the brine springs. It is also found in Ohio, Illinois, Virginia, Tennessee, Arkansas, and Nova Scotia. It is abundant in many parts of Europe.

An anhydrous sulphate of lime is found, which is called *Anhydrite*. [ANHYDRITE.]

Gypsum is used as a manure. [MANURES, in ARTS AND SC. DIV.]

GYPSY-WORT. [LYCOPUS.]

GYRACA'NTHUS, a genus of Fossil Placoid Fishes, from the Mountain Limestone and Coal Strata. There are four British species.

GYR-FALCON. [FALCONIDÆ.]

GYRINIDÆ, a family of Coleopterous Insects belonging to the section *Pentamera*, and the sub-section *Hydrodephaga*, or Water-Beetles, and distinguished by the minute size of the antennæ, which are clubbed and shorter than the head, the second joint being dilated into a kind of ear externally; the two fore legs are long and advanced in front like arms, but the four posterior legs are very short and compressed, but broad, forming two pair of short strong oars. The eyes are four in number, two being placed above and two below; the palpi are very small; the thorax short and transverse; and the elytra oval, depressed, and obtuse at the extremity, leaving the tip of the abdomen exposed.

This family corresponds with the genus *Gyrinus* of Linnæus, and unlike the *Dyticidæ* to which they are nearly allied, these insects are distinguished by the metallic brilliancy of their covering; living for the most part on the surface of the water, they receive the impressions of the light in a more direct manner than the *Dyticidæ*, and are accordingly ornamented with tints of a brassy or bronzed metallic hue, which glitter in the sun in the greatest degree. The velocity with which they execute their evolutions upon the surface of the water is really surprising, and has obtained for them the name of Tourniquets by the French, and Whirligigs and Waterflies by the English. Sometimes indeed they remain stationary for a time, so that it seems easy to secure them, but on the least motion they are instantly alert, escaping with surprising agility and diving to the bottom of the water. The situation of their eyes adds greatly to their defence, enabling them to see objects both above and below them. In the 'Journal of a Naturalist' we find the following account of their proceedings:—"Water quiet, still water affords a place of action to a very amusing little fellow (*Gyrinus natator*), which about the month of April, if the weather be tolerably mild, we see gamboling upon the surface of the sheltered pool; and every schoolboy who has angled for minnows in the brook is well acquainted with this merry little swimmer in his shining black jacket. Retiring in the autumn, and reposing all the winter in the mud at the bottom of the pond, it awakens in the spring, rises to the surface, and commences its summer sports. They associate in small parties of ten or a dozen near the bank, where some little projection forms a bay or renders the water perfectly tranquil; and here they will circle round each other without contention, each in his sphere, and with no apparent object from morning until night with great sprightliness and animation, and so lightly do they move on the fluid, as to form only some faint and transient circles on its surface. Very fond of society; we seldom see them alone, or if parted by accident they soon rejoin their busy companions. One pool commonly affords space for the amusement of several parties, yet they do not unite or contend, but perform their cheerful circlings in separate family associations. If we interfere with their merriment they seem greatly alarmed, disperse or dive to the bottom, where their fears shortly subside, as we soon again see our merry little friends gamboling as before. When they dive to the bottom of the water in the manner above described, they carry with them a little bubble of air affixed to the extremity of their bodies. Also they are sometimes to be found flying, their well-formed wings permitting such an operation, while the high polish of the body protects them from the action of the water." With the exception of a few exotic species, the insects of this family are of a small size, seldom exceeding a quarter of an inch in length; and the largest ones do not reach one inch. Some of the species are found on the margins of the ocean. They emit when touched a disagreeable scent, arising from a milky fluid which exudes from the different parts of the body, and which is not readily dispelled. The structure of the fore legs indicates their mode of life, serving as arms to convey the food, which they find floating upon the surface of the water, and which consists of small dead insects, &c., to the mouth. The number of species of this family does not exceed 50 or 60, and of these not more than eight or nine are found in this country; of these the *Gyrinus natator* is the most common. It is of a brilliant bronzy black colour, with the sides of the body and antennæ metallic; the margins of the elytra and legs reddish. The elytra are ornamented with lines of impressed spots. About a quarter of an inch in length.

GYRINUS. [GYRINIDÆ.]

GYROCARPUS, a genus of Plants containing few species, but these few are widely distributed—one being found in South America on the mountains of New Granada and Caracas, a second on those of the Coromandel coast, and two others in the tropical parts of Australia. *Gyrocarpus* has, in conformity to the opinion of Mr. Brown, been considered as allied to and by some it has been placed in *Lauraceæ*. Blume refers it to his new order of *Illigereæ*. Dr. Lindley considers it as belonging to *Combretaceæ*. The flowers are polygamous or hermaphrodite; the perianth superior, 4- to 8-fid; stamens 4, opposite to divisions of perianth; anthers 2-celled, with the cells opening by a valve from below upwards; drupe 1-seeded, having attached to it two long membranous wings, the prolongation of two divisions of the perianth as in *Dipterocarpeæ*. The embryo is inverse; the cotyledons twisted spirally. The American is so closely allied to the Asiatic species as to have been thought identical by Dr. Roxburgh. The latter grows to be a large tree with cordate leaves, which are deciduous about the end of the rainy season; after which the flowers make their appearance in the cold weather, but are shortly followed by the new leaves. The wood of this tree is whitish-coloured and very light. It is preferred whenever procurable for making the catamarans, or rafts, on which the natives come off to ships through the heavy surf of the Madras coast.

GY'RODUS (γῦρος, round, ὀδούς, a tooth), a genus of Fossil Fishes established by Agassiz. The mouth of these fishes was armed with rows of round grinding teeth in the palate for the crushing of hard *Crustacea* and fishes with bony scales. In very fine specimens five rows, which were placed on the os vomer in the roof of the mouth, remain in the stone, though no other part of the head is preserved; but generally the teeth are loose, and were in that state termed *Bufonites* by the old writers (Llwyd, &c.) on organic remains. (Buckland's 'Bridgewater Treatise.') The fishes of this genus belong to the Oolitic Strata.

GYROGONITES (γῦρος, round, γωνία, angle). This name was given by Lamarck to small fossil bodies found in fresh-water tertiary strata (Isle of Wight, near Paris, &c.), under the supposition that they were shells of Polythalamous *Cephalopoda*. ('Animaux sans Vertèbres,' tom. vii.) Lamarck was aware that his opinion was contested, and that some persons imagined the small globular transversely carinated *Gyrogonites* were the seeds of an aquatic plant, but he "could not believe it." It was however demonstrated in the 'Geological Transactions' (vol. ii., second series), that they were in truth the fruits of *Chara*, a genus of plants found in many fresh-water ponds. The stem and other parts of this plant are very calcareous. (Brongniart, *Histoire des Végétaux Fossiles*, article 'Characeæ;' Lyell, 'Memoir,' in *Geological Transactions*, vol. ii., new series.)

GYRO'LEPIS, a genus of Fossil Ganoid Fishes, from the New Red-Sandstone Strata and bone-beds of the Lias. There are three British species. (Agassiz.)

GYRO'NCHUS, a genus of Fossil Ganoid Fishes, from the Oolite of Stonesfield. (Agassiz.)

GYROPHORA. [LICHENS.]

GYROPRI'STIS, a genus of Fossil Placoid Fishes, from the Red-Sandstone near Belfast. (Agassiz.)

GYRO'STEUS, a genus of Fossil Ganoid Fishes, from the Lias. (Agassiz.)

END OF VOLUME II.

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